Project No. 14-45

The following document was produced as part of NCHRP Project 14-45, and is supplemental to *NCHRP Research Report 1098: Guide for Response Planning, Assessment, and Rapid Restoration of Service of Bridges in Extreme Events*, which can be found on the National Academies Press website (nap.nationalacademies.org).

RESPONSE PLANNING, ASSESSMENT, AND RAPID RESTORATION OF
SERVICE OF BRIDGES IN EXTREME EVENTS

FINAL REPORT
PART 4: USER MANUAL FOR TOOL

Prepared for
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
(NCHRP)
of
The National Academies of Sciences, Engineering, and Medicine

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February 2023

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AUTHOR ACKNOWLEDGEMENTS

Chapter 1: Introduction

1.1 Background

The Bridge Assessment and Rapid Restoration Tool (BARRT) facilitates the use and implementation of the *Guide for Response Planning, Assessment, and Rapid Restoration of Service of Bridges in Extreme Events*. State DOTs often have several platforms, locations, and methods used to outline their planning, assessment, and rapid restoration procedures. A unified platform that contains links, documents, and manuals of the State DOT's resources is advantageous to allow for quick communication and action. The BARRT was developed to serve as this platform, which contains guidance on planning, assessment, and rapid restoration for bridges and culverts. BARRT is customizable, and can be updated to house pre-existing procedures and documents in addition to newly developed information.

1.2 About this User Manual

This User Manual describes how to use BARRT to aid with the planning, assessment, and rapid restoration phases of an extreme event. For an optimal experience, users are highly encouraged to first review this manual prior to using the tool. For those wishing to customize the tool, please refer to the sections on how to customize the tool are also provided.

The User Manual includes details on the following procedures:

- Unzipping the tool
- Enabling macros in Microsoft products to run features within the tool
- Running the main BARRT tool and subsequent tools with step-by step instructions.

The User Manual follows the coding convention elaborated in Table 1-1 to clarify suggested actions and referenced elements.

Table 1-1. Symbol and Coding for the User Manual

Symbol/Coding	Meaning
Underline Text	Emphasizing Text or Directions
Italic Text	References a command or action required by the user or developer
Red Text	Name of BARRT Tool
Green Text	Name of an Excel Workbook or Word Document
Blue Text	Name of an Excel Worksheet
Bold Text	File or Folder Name; Name of a Folder Group
Orange Text	Output Document (Word Document, etc.)

1.3 BARRT Capabilities

BARRT contains the following tools presented in Table 1-2.

Table 1-2. Tools available within BARRT

Type	Tool	Description or Purpose
Interactive PowerPoint Tools	Planning	Contains flowcharts and processes used to prepare for an emergency event. It is complemented by the EEAP tool.
	Assessment	Outlines typical assessment methods, suggested forms, and anticipated outcomes for each type of assessment. Forms are available for download (digitally or for printed copies), making it easier to share common forms across agencies.
	Rapid Restoration	Presents common restoration procedures that may be implemented for extreme event use. It is complemented by the BSAP tool.
	Contracting	Describes common contracting and procurement methods that are used in emergency situations. Provides some examples of these methods, and placeholders for transportation agencies to easily upload agency-specific pre-existing forms.
	Help Guide/ Tutorials	Documentation on how to use the tool and how to customize and update it based on a specific State DOT's need.
Excel/ Word Based Tools	Emergency Event Action Plan (EEAP)	Creates a high-level plan based on the characteristics of the specific event. Aids in the determination of appropriate response levels and courses of action in the response phase.
	Bridge Specific Action Plan (BSAP)	Supports the restoration plan of a specific structure based on the nature and extent of damage and type of bridge. This tool links repair methods discussed in AASHTO's *Guide to Bridge Preservation Actions* and other primary sources to NBI elements with a user input form.
	Case Study Tool (CST)	A platform to share and explore information from prior events and create new examples based on current events.
	Status Form	A template form to update the changing emergency response status to share with stakeholders. This template can be used to reflect a time-history of the response methods, current operations, resources deployed, and contact information of those with additional information.
	Contact Form	A template for transportation agencies to update their contact information that could be potentially shared with other agencies for transparency and general information sharing.

1.4 BARRT Customization

In most cases, users will not need to edit or customize BARRT to enjoy it in its full capacity; however, for agency-specific information, customization may increase productivity or help keep contents up to date. For those wishing to use the tool as is, please refer to the disregard sections on BARRT Customization. For those wishing to customize BARRT, it is recommended that Developers have a full understanding of the User Manual as well as experience with the basic operations of BARRT prior to performing customizations.

The User Manual includes details on the following customization processes:

- Adding content to the BARRT Interactive Microsoft PowerPoint
- Editing templates for EEAP, BSAP, CST
- Reorganizing and adding new content to EEAP, BSAP, CST, Status Form, and Contact Form

It is expected that those performing customizations have a thorough understanding of Microsoft Office, especially Word, Excel, and PowerPoint. However, for advanced modifications or expansion of BARRT, the visual basic for applications (VBA) code integrated within MS Office can be edited. When necessary, those wishing to perform advanced in-depth customizations should contact others in their department(s) who are familiar with VBA. In most cases, the VBA code does not need to be edited to implement most of the basic customization features anticipated.

This *Developer Guide* follows the coding convention elaborated in Table 1-1 to clarify suggested actions and referenced elements.

Note that the developer guide was produced with the "dark" display theme for Microsoft Office. Developers using the "light" theme will have a different background and font colors compared to the figures in this document, but the content should match. Menus may also slightly vary between different versions of Microsoft Office.

1.4.1   System Requirements

Those wishing to perform customizations to BARRT will need a computer with MS Windows Operating System that is equipped with full versions of Microsoft Office (specifically Word, PowerPoint, and Excel). Although, some components of BARRT function on IOS devices, those have limited functionality and may not be used for editing. Microsoft Office 365 Version 2022 was used to create all features of BARRT; however, the tool is generally backwards compatible with relatively recent versions of Microsoft Office and should be compatible with future versions as long as Microsoft maintains compatibility. This platform was chosen given that it is ubiquitous within transportation agencies with many staff with extensive experience with the platform. For developers interested in performing in-depth modifications, the VBA extension is required.

1.4.2   BARRT Customization Capabilities

The following features are customizable and discussed in this manual (Table 1-2). For in-depth edits and modifications, developers should be familiar with VBA coding to expand the functionality (See Chapter 8). There are a wide variety of motivations behind the desire to customize BARRT. With customization, developers can add additional tools or analysis features, upload agency-specific documents, upgrade to the latest versions of Microsoft Office, and troubleshoot any issues. With this customization comes levels of editing. Base-leveling editing includes content editing, formatting, and uploading links or files to the interactive PowerPoint. In-depth editing includes adding or changing VBA code for the external tools such as EEAP or BSAP. In either case, developers have the freedom to make changes that will best meet the needs of the State DOTs.

Table 1-3. Customizable Features within BARRT

Type	Tool	Customizable Features
Interactive PowerPoint Tools	Planning	• Adding or removing slides based on agency-specific needs • Uploading and linking agency-specific documents, resources, manuals, and codes
	Assessment	
	Rapid Restoration	
	Contracting	
	Help Guide/ Tutorials	N/A
Excel/Word Based Tools	Emergency Event Action Plan (EEAP)	• Adjusting event-specific metrics for different response levels based on local hazards, infrastructure condition, and design codes • Editing recommendations for each event type and response level • Modifying the Word document template with agency logos, content, or other details
	Bridge Specific Action Plan (BSAP)	• Specifying agency-specific elements or defects • Adding or adjusting matched restoration options with defects and elements • Filtering restoration results by keywords and percent damaged of specific element • Modifying the Word document template with agency logos, content, or other details
	Case Study Tool (CST)	• Modifying the Word document template with agency logos, content, or other details • Adding new case studies to the Case Study Library
	Status Form	• Modifying the Word document template with agency logos, content, or other details
	Contact Form	• Modifying the Excel worksheet template with agency logos, content, or other details

1.5 BARRT File Directory

BARRT is self-contained in a series of folders that can be saved to users' and developers' personal computers or hosted on an agency-wide network. BARRT is provided as a zip file (**BARRT.zip**). Once unzipped, the root folder of BARRT is divided into a series of subfolders that house each of the individual tools, supporting documents, interactive PowerPoint, and the *User* and *Developer Guides*. A description of the files in the **BARRT file directory** is given in Table 1-4 and a summary of the structure is shown in Figure 1-1.

Table 1-4. BARRT File Directory Folder Descriptions

Folder Name or Subfolder Name	Description
00_Help	PDFs of the User and Developer Guides
01_Tool_Library	PDFs of documents referenced in the Interactive PowerPoint. Files are saved by author_year, with the exception of Manuals which are saved by their name\report number
02_Editing	The.pptx file containing the BARRT Interactive PowerPoint that can be edited.
03_EEAP	Folders and files required to run EEAP
EEAP_Lookup	EEAP lookup tables to auto populate forms
Generated_EEAPs	EEAP documents generated by the users organized by event type
04_BSAP	Folders and files required to run BSAP
BSAP_Library	PDFs with supporting element repair information for BSAP.
BSAP_Lookup	The BSAP lookup tables to populate the forms
GeneratedBSAPs	Contains the BSAPs generated by the user
05_CaseStudies	Folders and files required to run the Case Studies
CaseStudies_Lookup	Contains the Case Study lookup tables to auto populate forms
Generated_CaseStudies	Contains PDFs of the Generated Case Studies organized by event type
Original_Word_Docs	Source word documents for the PDFs that are included in the Generated_CaseStudies folder
06_Status_Form	Template file for the Status Form
07_Contact_Form	Template file for the Contact Form

Tool.zip

- 00_Help → User Manual
- 01_Tool Library
- 02_Editing → Tool.pptx
- 03_EEAP
  - EEAP_Lookup
  - Generated_EEAPs
  - EEAP.xlsm
  - EEAP_Template.dotx
- 04_BSAP
  - BSAP_Lookup
  - GeneratedBSAPs
  - Library
  - BSAP.xlsm
  - BSAP_Template.dotx
- 05_CaseStudies
  - CaseStudies_Lookup
  - Generated_CaseStudies
  - Original_Word_Docs
  - CaseStudies.xlsm
  - CaseStudies_Template.dotm
- 06_Status_Form → Template_StatusForm.docx
- 07_Contact_Form → Contact_Form.xlsx
- Tool.pptx

Figure 1-1. BARRT File Directory Structure

Chapter 2: BARRT Installation

2.1 System Requirements

To use all features within BARRT, users are required to have a Windows Operating System that is equipped with full versions of Microsoft Office (Word, PowerPoint, and Excel). The core BARRT platform runs within Microsoft PowerPoint but directly links to features within Excel and Word as needed for other tools. BARRT is currently not compatible with Mac OS X. Tablets that run IOS may be used to access several of the BARRT tools, but are unable to run the more advanced tools, which rely on macros in Microsoft Excel and Word to run Visual Basic for Applications (VBA) code to operate. (Note that users do not need to have a knowledge of VBA to use the tools).

2.2 Enabling Macros

Many BARRT tools (EEAP, BSAP, and the CST) require that macros are enabled in both Microsoft Word and Excel. To enable Macros (Figure 2-2):

- Navigate to the *file* tab within Excel (or Word) before opening BARRT,
- Click on *Options* (1).
- Click on *Trust Center* (2),
- Go to *Trust Center Settings* (3).
- Click on *Macro Settings* (4), and
- Select *enable VBA macros* (5).

Repeat this process for Word (or Excel).
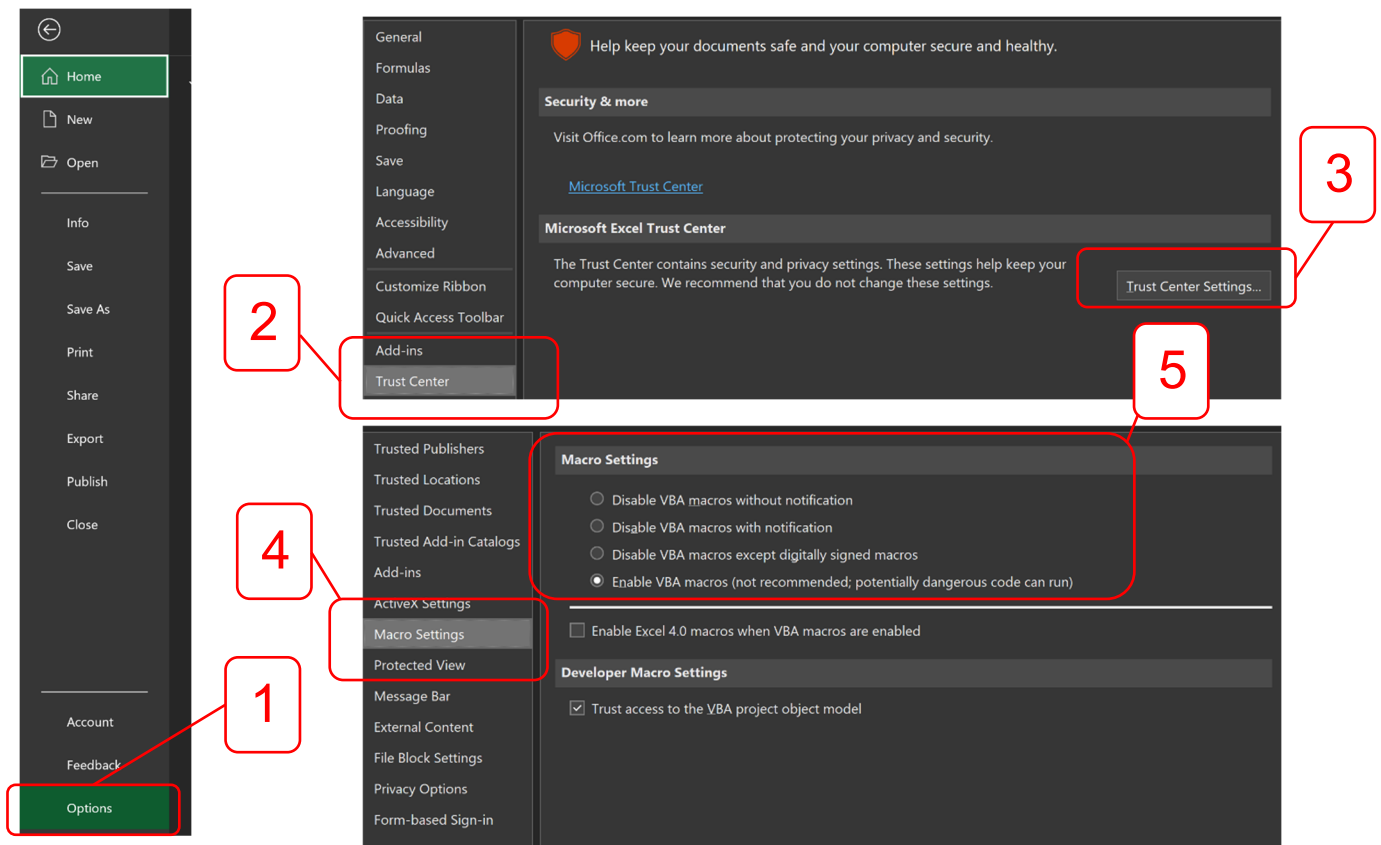
Figure 2-2. Enabling Macros in Microsoft Excel or Word

2.3 Disabling Protected Mode

The BARRT tools require protected mode to be turned off to permit Macro editing in Word and Excel. These settings need to be updated in both Microsoft Word and Excel. Similar to enabling Macros, to disable protected mode (Figure 2-3) users:

- Navigate to the file tab within Excel (or Word),
- Click on Options (1).
- Click on Trust Center (2),
- Go to Trust Center Settings (3),
- Click on Protected View (4),
- Unselect Enable Protected View from files originating from the internet, and
- Enable Protected View for files located in potentially unsafe locations (5)

Repeat this process for Word (or Excel). If protective mode is not enabled, then outputs for BSAP, EEAP, and the CST will not be permitted to save and close. It may be necessary to have your IT staff grant these permissions.
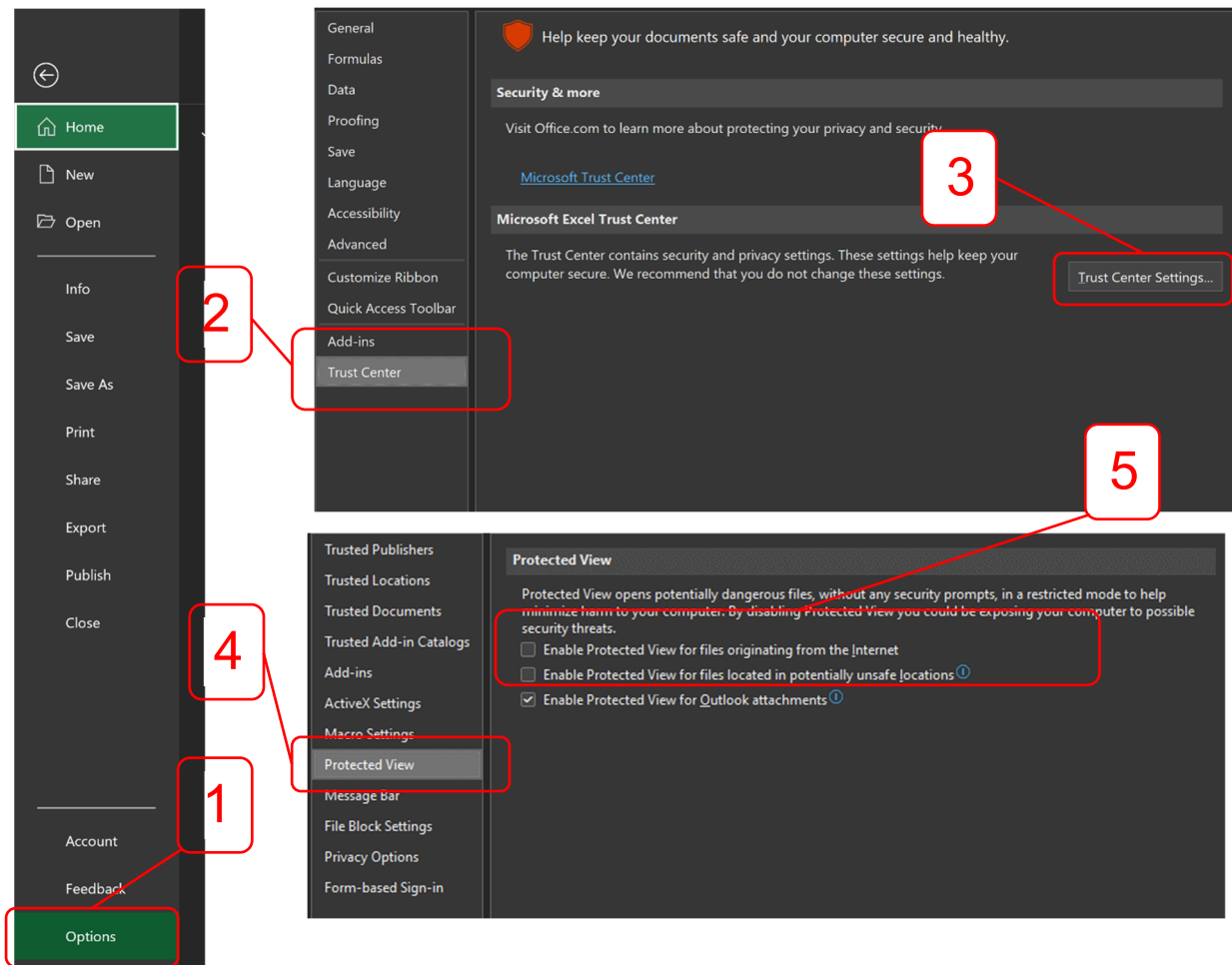
Figure 2-3. Disabling Protected View in Excel or Word

2.4 Downloading and Installing

When first using BARRT, users need to save the .zip file in a desired location on their computer. The tool can be found on the National Academies Press website (nap.nationalacademies.org) by searching for NCHRP Research Report 1098: Guide for Response Planning, Assessment, and Rapid Restoration of Service of Bridges in Extreme Events. Next, the BARRT folder must be unzipped to access the main **BARRT** platform and the tools. To unzip the BARRT folder (Figure 2-4):

- Navigate to the zipped folder.
- Right-click on the zip file and select *Extract All.*
- A popup message will confirm the location of the extracted files.
- Click *Browse* to change the location of the extracted files. By default, the files will be extracted in the same location as the downloaded zip file.
- Once the desired location is chosen, select *Extract* to extract the files.

If the BARRT folder is saved locally to a device, then BARRT can function without connection to the internet (with the exception of links to websites for additional information).
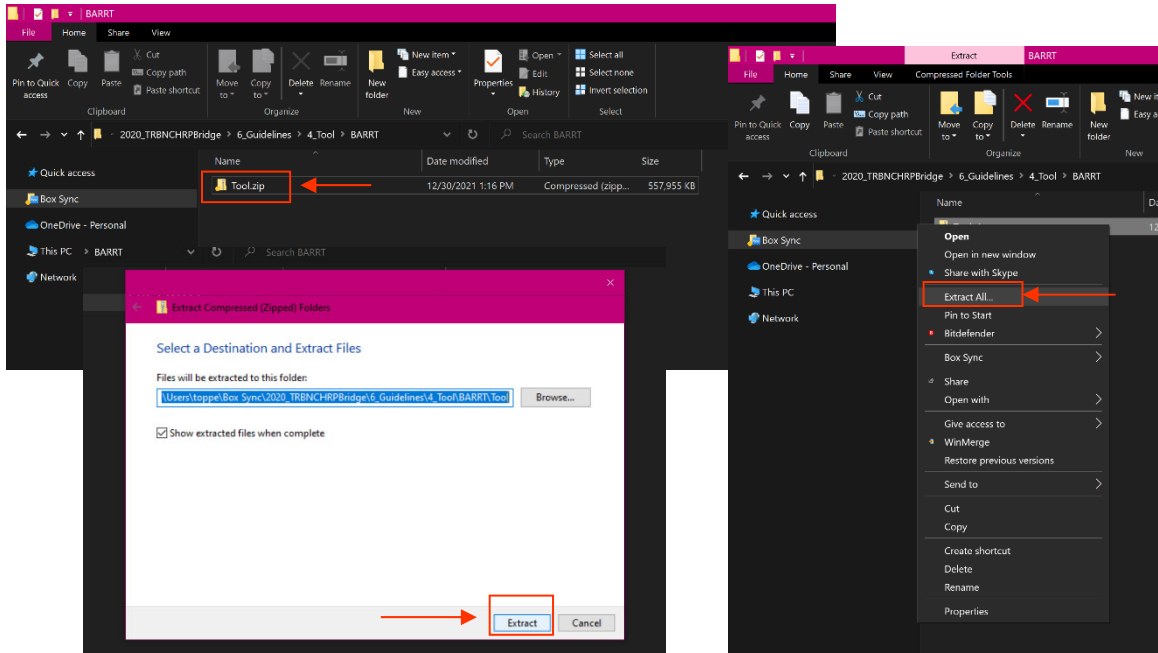
Figure 2-4. Downloading and Unzipping BARRT

2.5 Opening and Running BARRT

Once BARRT is unzipped, users can open on the **Tool.ppsx** file to access BARRT (Figure 2-5). The BARRT PowerPoint platform provides an interactive, intuitive experience with a website-like feel to access the tools from a single platform and will be described in Section 3.0.
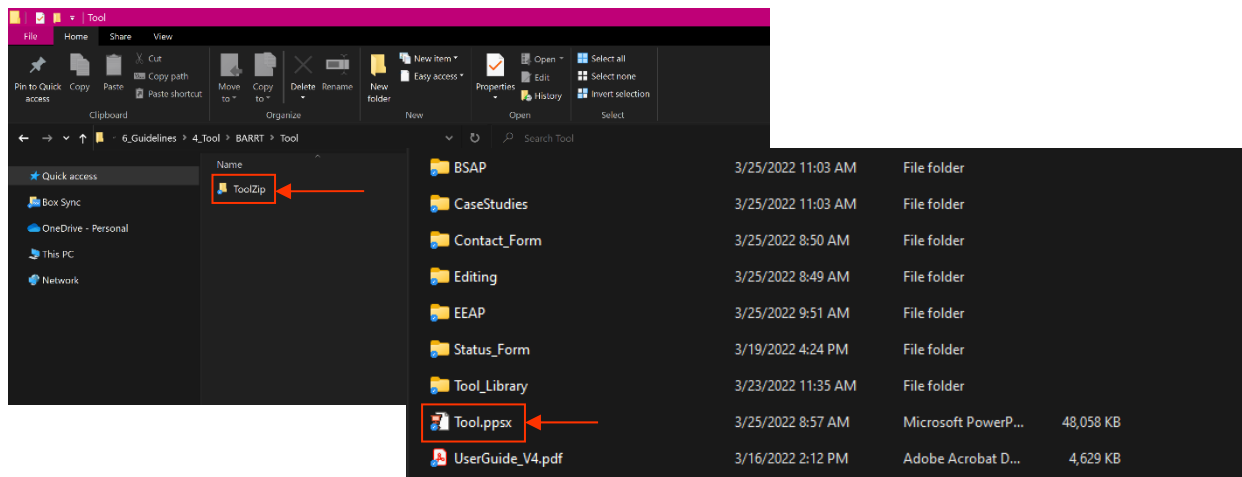
Figure 2-5. Opening and Running BARRT

Chapter 3: BARRT Interactive PowerPoint

3.1 Overview

The BARRT Interactive PowerPoint repackages key information found in the Guide (*NCHRP Research Report 1098*) into a digital, interactive platform. Users can access the main BARRT tools without access to the internet if it is housed locally on a user's device. All tools within BARRT can be accessed from this homepage at the click of a button or link (Figure 3-1). The landing page consists of the following information:

- Four Tabs (A) at the top link to the main tools within BARRT, including Planning, Assessment, Rapid Restoration, and Contracting Tools.
- The Help link (B) directs users to the User Manual (this document), Developer Guide, tutorial videos, and slide templates for customization.
- A row of buttons (C) provides links to the NAP website where NCHRP documents connected to BARRT can be found. These include NCHRP Research Report 1098 and Web-Only Document 390, links to access the other NCHRP Reports, and links to AASHTO documents that were foundational to the development of BARRT.
- A row of tools (D) provides links to access the primary BARRT tools (Table 1-2) that are housed in Excel, Word, or PDFs. Many of these tools require macro-enabled Windows based devices.
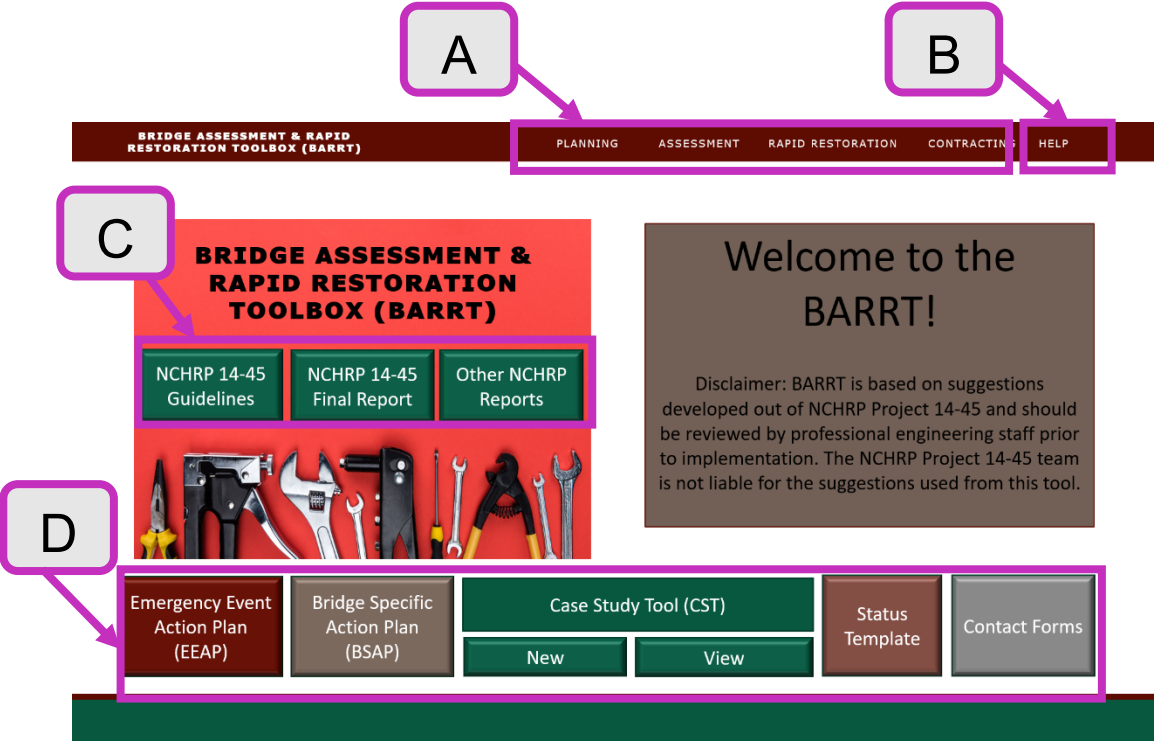
Figure 3-1. BARRT Homepage Showing Links to Tools and Documents Housed within BARRT

3.1.1 BARRT PowerPoint Platform

In the BARRT PowerPoint users can advance slides by using the mouse to click on the different tabs and buttons. The main BARRT tabs (Planning, Assessment, Contracting, and Rapid Restoration) are accessed by clicking on the corresponding tab in the upper navigation bar (Figure 3-1) on the BARRT homepage. Note that this platform functions similar to a website rather than a linear PowerPoint presentation as most users are accustomed to.

3.1.2 BARRT File Directory and Alternative Access to Excel/Word Based Tools

For the richest experience, users would normally access BARRT using the PowerPoint platform outlined in Section 3.0. However, some advanced users may wish to access the Excel/Word based tools directly. To operate these tools directly outside of BAART, users can navigate directly to the appropriate folder within the BARRT unzipped folder (Figure 3-2). For more specific information on opening the individual tools, see the corresponding tool sections in this guide.
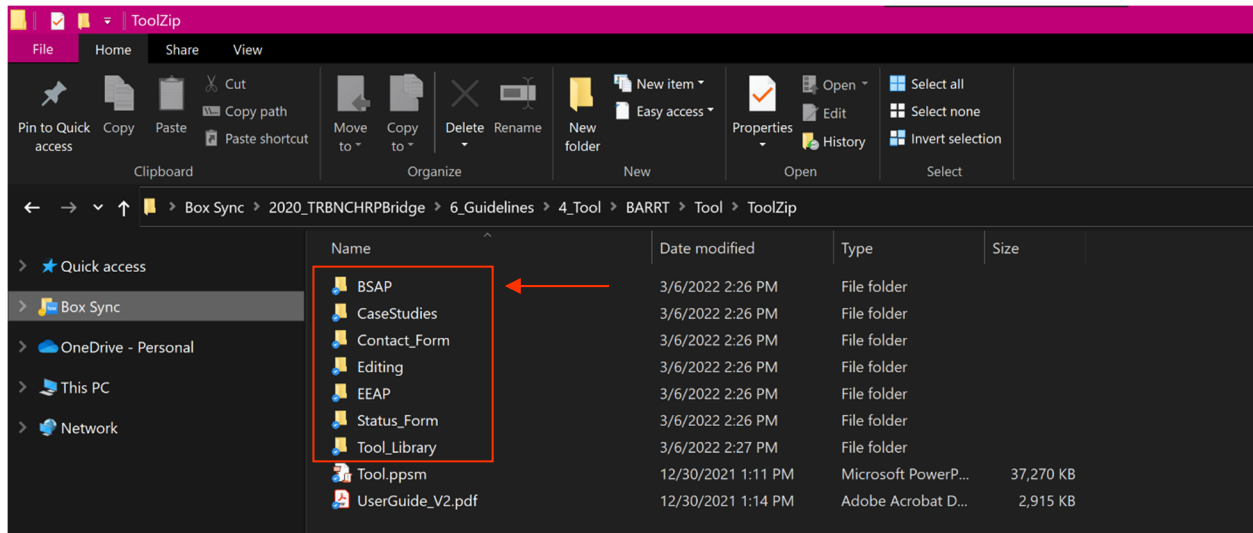
Figure 3-2. Opening BARRT Tools from the File Directory

3.2 How it Works

The BARRT PowerPoint platform opens in presentation mode of PowerPoint, which simulates a website-like user interface. This platform locks the keyboard function, so users navigate across the tool using the mouse and clicking on the desired tabs and buttons. Users open the main tools from the top navigation bar. The name of the desired tool is clicked on, which opens the corresponding tool (Figure 3-3). Once a specific tool is opened, the tab changes colors from white to green.

Figure 3-3. Opening a Tool from Top Navigation Bar

To return to the BARRT homepage, users can click on *Bridge Assessment & Rapid Restoration Toolbox (BARRT)* tab in the upper-left corner (Figure 3-4).

Figure 3-4. Returning to the BARRT Homepage from the Top Navigation Bar

To navigate through each tool, users may use the bottom navigation bar (Figure 3-5). On pages within each tool, the *return to previous* button and *home* buttons are available. If clicked on, these buttons return users to the page they were previously viewing or returns users to the home page of the tool, the user is currently accessing, respectively. Depending on the tool and the current page, the *advance to next view* button may be visible (Figure 3-5).

Figure 3-5. Bottom Navigation Bar

The *advance to next view* button is only visible on multi-page sections, which are denoted by the circular dots in the upper right-hand corner of the slide (Figure 3-6).

Figure 3-6. Multi-page Section Arrows

3.2.1   Accessing Content (Photo Boxes, Photo Links, and References to Guidelines)

When a page contains *heading photo boxes*, users can view the page(s) associated with each *heading photo box* by clicking on the corresponding image (Figure 3-7).

Figure 3-7. Navigating with Heading Photo Boxes

If a tool contains *photo links* (e.g., images of reference documents), users can double click on the image to navigate to a PDF or website link to view the document (Figure 3-8). All PDFs are stored in the Tool Library. For purchase-only documents, such as the *Manual for Bridge Evaluation*, links to the corresponding AASHTO store are tagged to the image.

Figure 3-8. Example of Accessing Documents via Photo Links

The content in BARRT complements the information found in the Guide (*NCHRP Research Report 1098*). The Guide section corresponding to the content in BARRT is listed under each section heading (Figure 3-9).

*Figure 3-9. Example of References to Corresponding the Guide (*NCHRP Research Report 1098*) Sections*

3.2.2 Closing BAART

Users can close BARRT by pressing the *escape* button on their keyboard.

3.3 Tool Library

The Tool Library contains PDFs of documents that are referenced as additional resources throughout BARRT. As documents are referenced in BARRT, they are linked to the individual PDF of the document. The entire tool library can be accessed directly from the **BARRT file directory** (Figure 3-10).

The Tool Library PDFs are named by the author and year (e.g., Culmo 2011) or the name of the manual (e.g., NCHRP Report 777). Users should be aware that some manuals (e.g., AASHTO's *Guide to Bridge Preservation Actions*, AASHTO's *Manual for Bridge Evaluation*, etc.) are not included in the Tool library even though they are referenced given that these documents must be purchased. Users are encouraged to

save and upload their own copies of these documents in the Tool library and update the links in BARRT to keep all references in a single location.
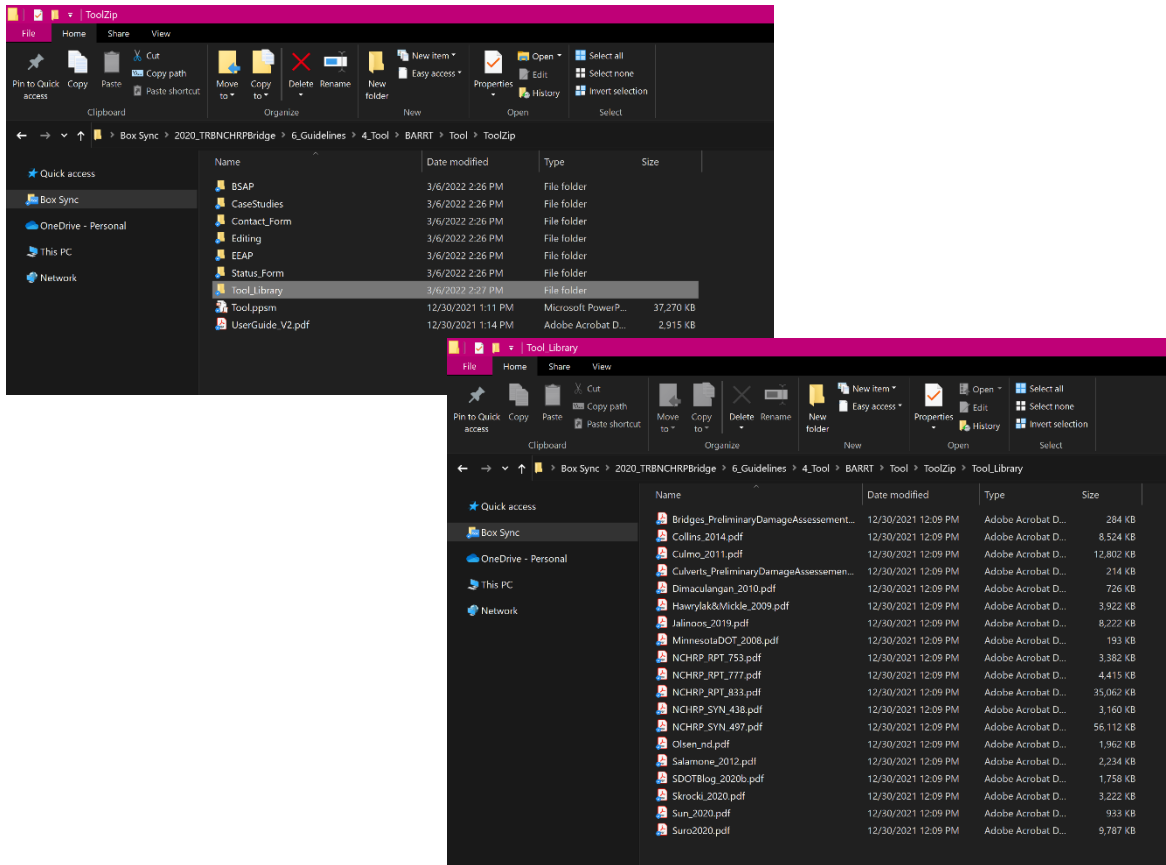
Figure 3-10. Opening the Tool Library

3.4 Editing BARRT PowerPoint

For users, the BARRT Interactive PowerPoint is saved and viewed as a Microsoft PowerPoint Slide Show (.ppsx). This opens the PowerPoint directly into Presentation mode without the slide pane on the far left as seen with conventionally saved PowerPoints (.ppt,.pptx). As a result, developers cannot make edits to BARRT from the Slide Show file. An identical version of BARRT is saved as a Microsoft PowerPoint Presentation file in the **Editing** folder within the **BARRT directory** as a .pptx file. This file type will open in PowerPoint with the format that most developers are most familiar with (Figure 3-12). When ready to publish, the .pptx file can simply be saved as a .ppsx and copied to the root directory.

To open the Presentation PowerPoint file, developers browse to the *Editing* folder in the **BARRT directory** and then copy the **Tool.pptx** file (Figure 3-11), which was used to create BARRT, to the main **BARRT** directory. Then open the file. (*Note that the file needs to be in the root directory for the links to work correctly as they are relative links*). From here, developers can continue to make edits and customize BARRT as desired.
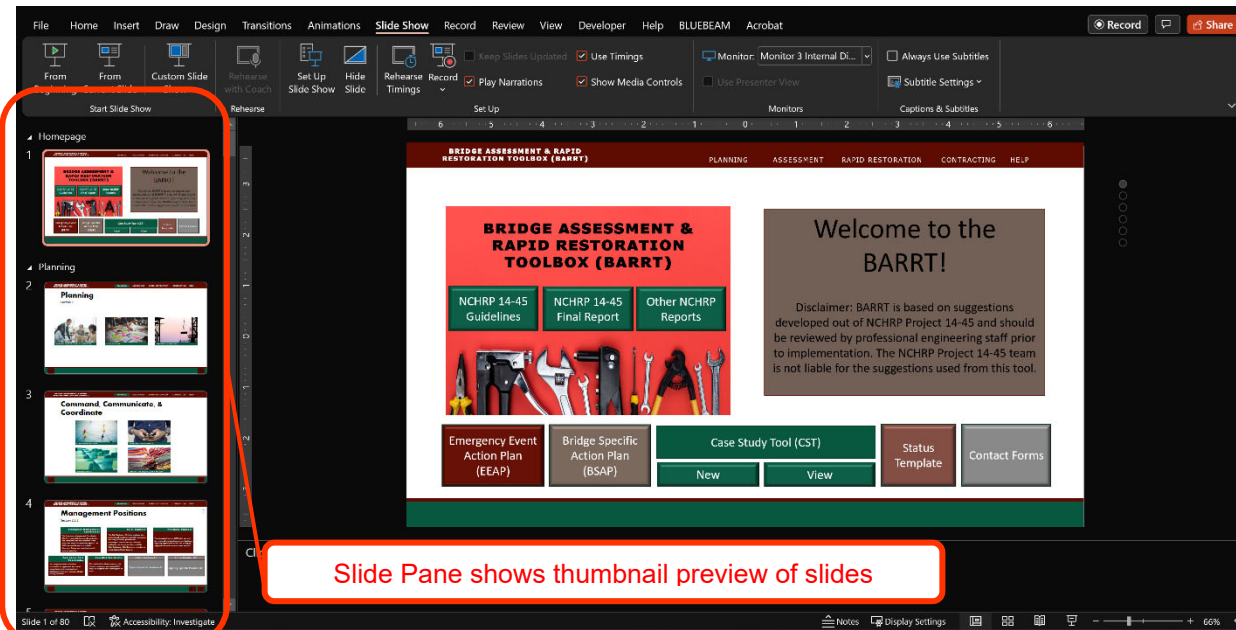
Figure 3-12. Typical View from Microsoft PowerPoint Presentation File
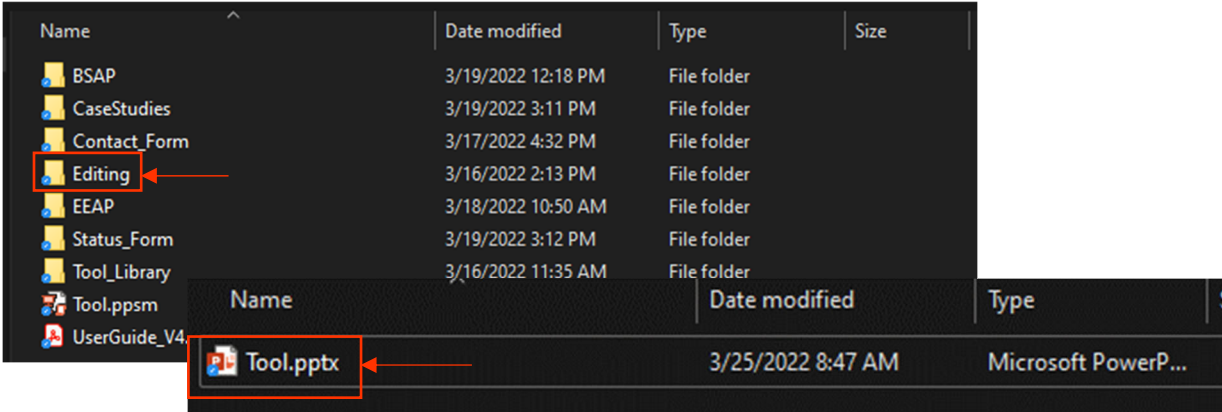
Figure 3-11. Opening the BARRT PowerPoint Presentation

3.5 Customizing Slides

BARRT is built using a series of headings (sections) and subsequent slides. The headings organize the slides into sections and follow the items along the top navigation bar: Introduction, Planning, Assessment, Rapid Restoration, Contracting, and Help. Each heading has its own set of Master Slides and accompanying layout slides, which can be edited using the Slide Master feature (See Section 3.5.1). Layouts from the Slide Master can be applied and changed for each PowerPoint slide to meet the required formatting needs and to keep content consistent across slides.

3.5.1 Slide Master

As with any Microsoft PowerPoint document, the Slide Master can be used to make edits to the slide templates. The Slide Master is the base slide that is referenced by PowerPoint for layouts, fonts, colors and other effects. It is highly recommended that developers edit the Slide Master if they want to make consistent formatting edits across all slides or a set of slides (i.e., edit the top or bottom navigation bars, etc.). To open the Slide Master, developers first click on the *view* ribbon, then click on *Slide Master* (Figure 3-13).
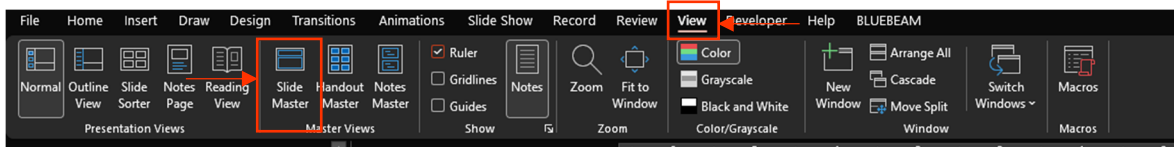
Figure 3-13. Opening the Slide Master

A hierarchy of slide thumbnails will appear in the slide pane (Figure 3-15). BARRT consists of six different Slide Masters, one for each section used in BARRT: *Introduction, Planning, Assessment, Rapid Restoration, Contracting, and Help*. The names of the Slide Masters are shown when hovering over each one with the mouse. Below the Slide Masters are the corresponding layout slides. To make edits to a particular section, developers first select the corresponding Slide Master (e.g., Assessment)). Then, changes can be made to the font, new textboxes or links can be added, and so forth. If edits only need to be made to one specific layout, such as editing the subheading fonts, edits are made directly to that layout slide (Figure 3-16). If additional tabs along the top navigation bar need to be added, the Slide Master for each heading should be updated with the new tab and link to permit full navigation capabilities within each tab. Performing edits in the Slide Master view will update all of the corresponding slides in the PowerPoint (Figure 3-14).
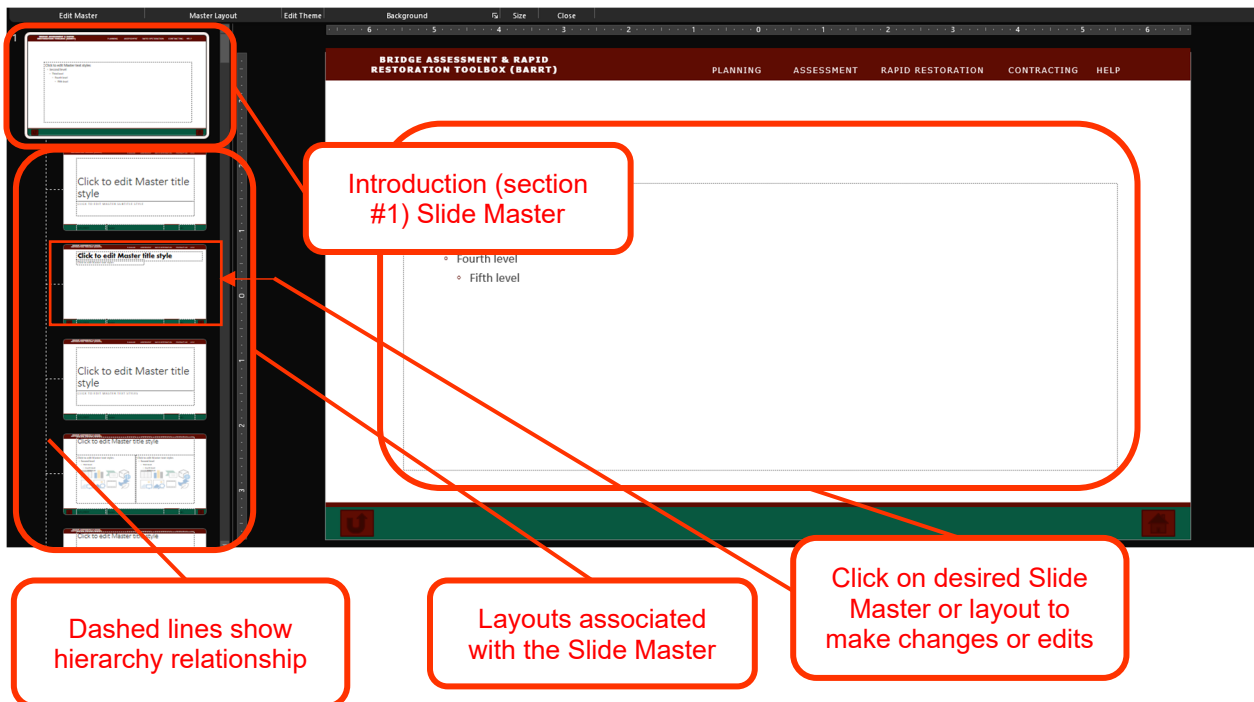
Figure 3-14. Making Edits to the Slide Master and its Subsequent Layout Slides
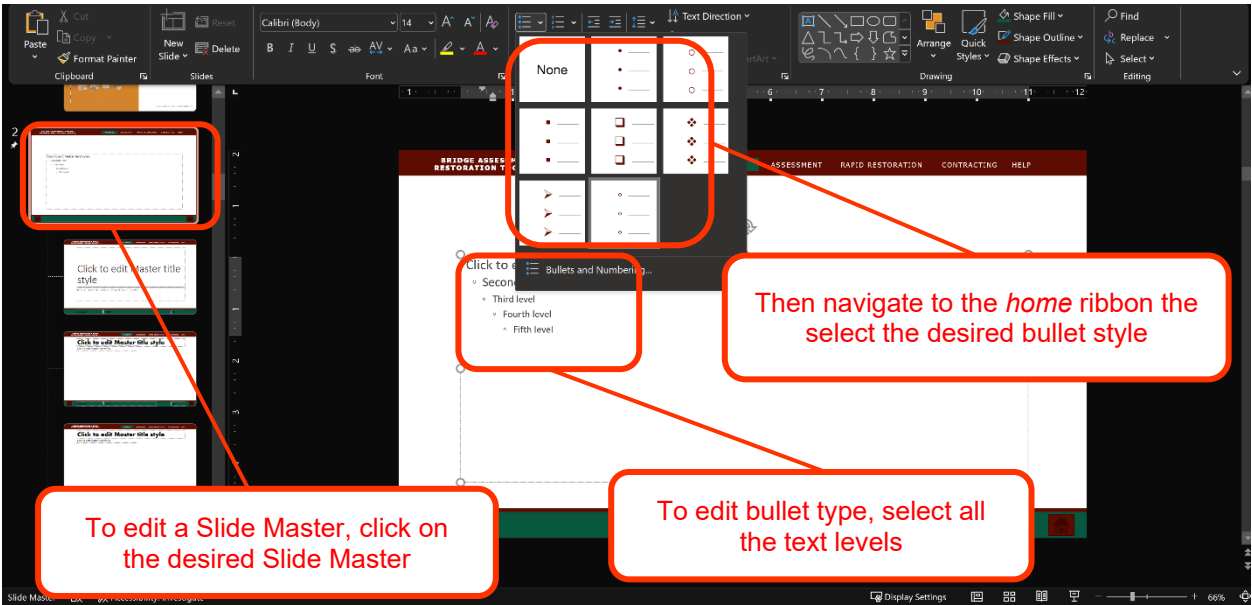
Figure 3-15. Example of Editing a Slide Master
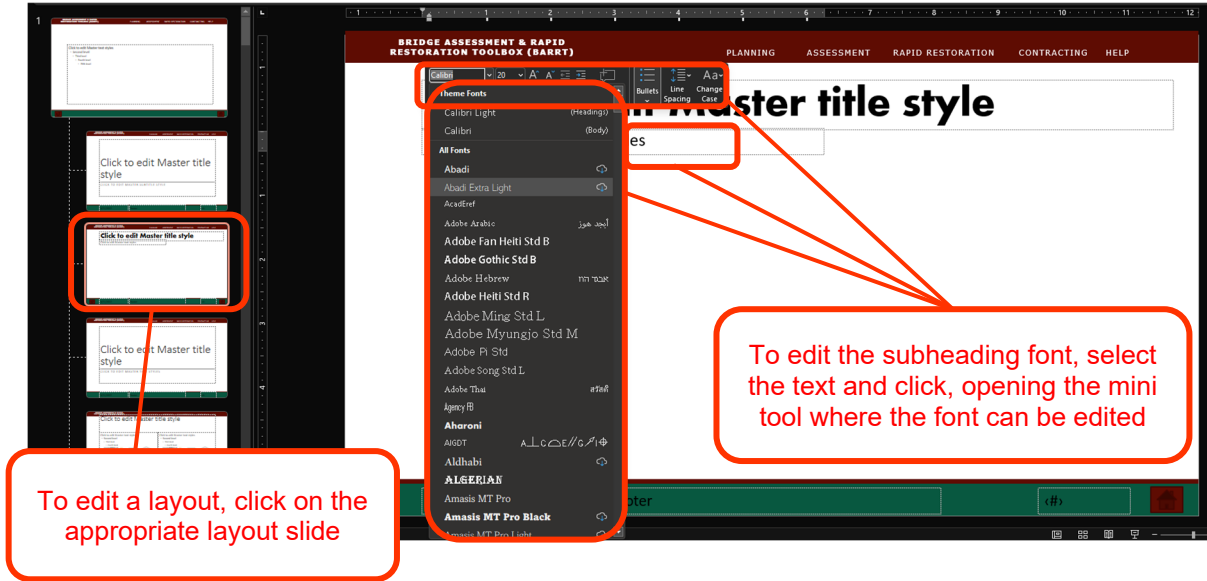
Figure 3-16. Example of Editing a Singular Layout Slide

This method should be used when making multiple edits to a set of slides to reduce time and maintain consistency. To close out of the Slide Master view, navigate to the *Slide Master* ribbon and click *Close Master View* (Figure 3-17).
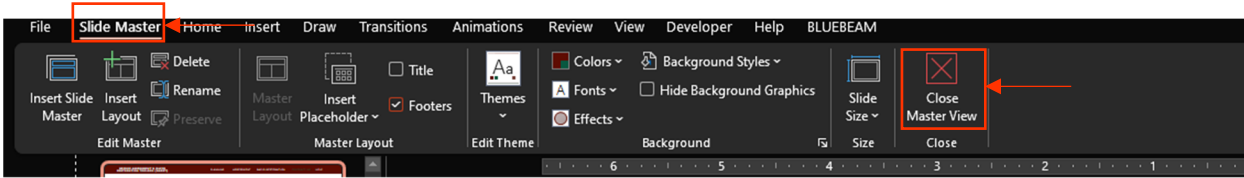
Figure 3-17. Closing the Slide Master View

3.5.2 Adding New Slides and Layouts

To add a new slide, click on the desired new slide location in the slide pane. Then, click on the *new slide* button on the *home* ribbon in PowerPoint, or press *ctrl-m* on the keyboard (Figure 3-18).
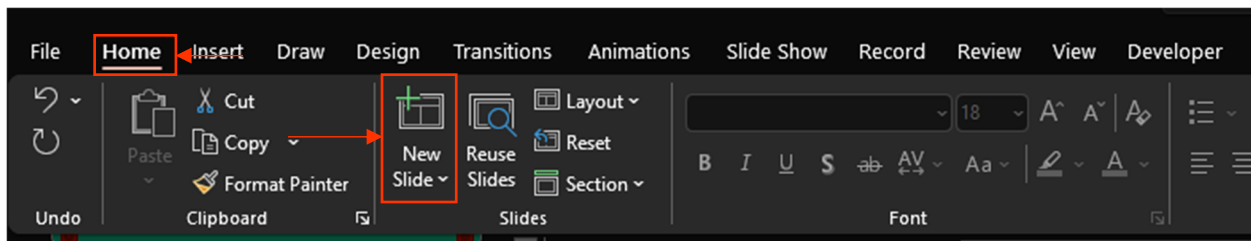
Figure 3-18. Adding a New Slide to BARRT

To modify the layout, right click on the newly created slide in the slide pane and select *layout.* From here, one can select the appropriate slide layout from the popup window (Figure 3-19). You need to choose the layout within the appropriate heading to ensure the top navigation bar is displayed correctly for that slide. With the layout selected, the format of the slide will then update to the new layout. The font, color, and other styles will default to the ones selected in the corresponding Slide Master.
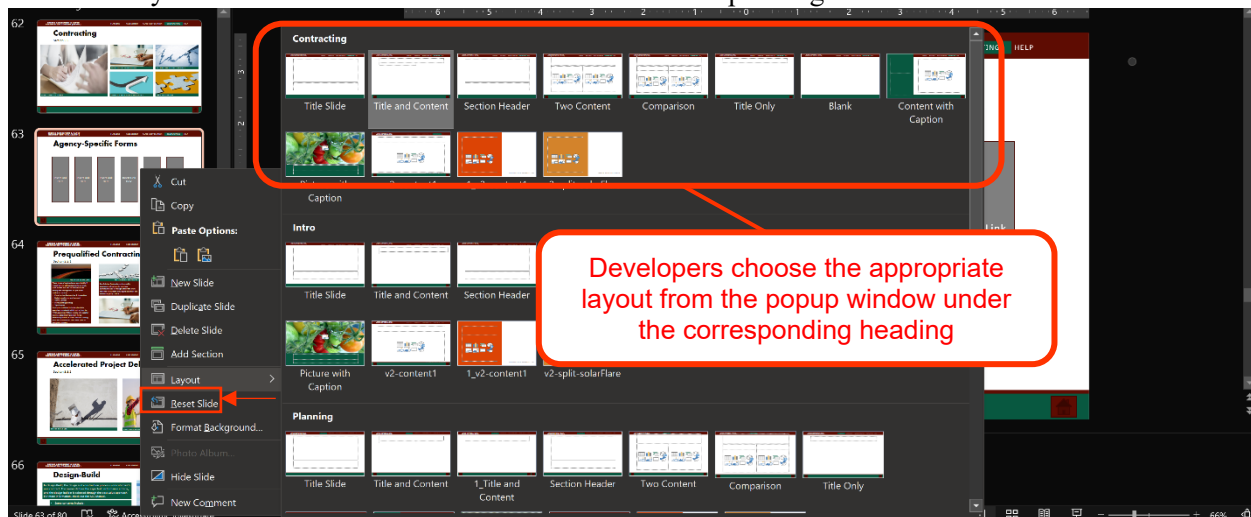
Figure 3-19. Selecting a Layout for a Slide

3.6 Customizing Content

Most existing content of BARRT can be edited using ordinary methods for editing a PowerPoint presentation; however, the following sections discuss some features that are unique to BARRT.

3.6.1   Textboxes

One can add new textboxes to new or existing slides throughout BARRT. Templates for textboxes are available in BARRT under the *help* tab. You can click on the *help* tab followed by *textbox templates* to navigate to the correct slide, or one can scroll through the slide pane to the help section and locate the *textbox templates* slide. In either case, one can then copy and paste the desired template(s) to the appropriate slide (Figure 3-20). Textboxes may need to be modified to fit the desired shape, font styles (bullets, justification, etc.) and layouts.
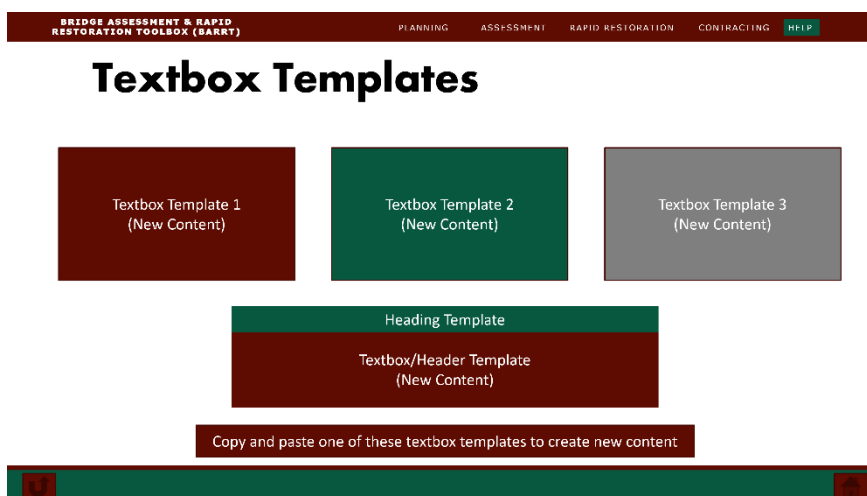
Figure 3-20. Textbox Templates Slide

3.6.2 Buttons

Developers can edit existing buttons or add new buttons throughout BARRT. To edit an existing button, developers first click on the button to select it, then right click, and select *edit link* (Figure 3-21). This opens the edit link popup window where developers can navigate to a place in the PowerPoint to change the link to, or add a new link from another document or website.

To add a new button, developers first navigate to the *help* tab on the top navigation bar or scroll through the slides to the help section (Figure 3-22). Developers click on *button templates or scroll to the button templates* slide (Figure 3-23). From here, developers can copy and paste the desired button to the appropriate slide. Buttons can also be resized as necessary. The button link can then be edited using the process outlined above.
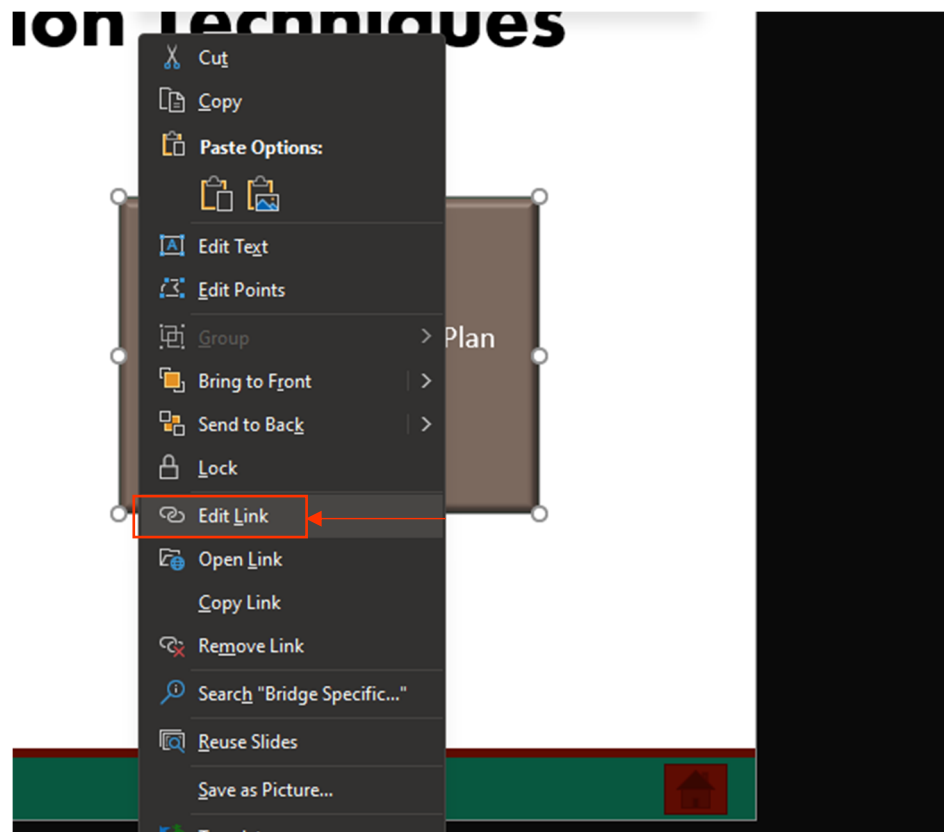
Figure 3-21. Editing an Existing Link
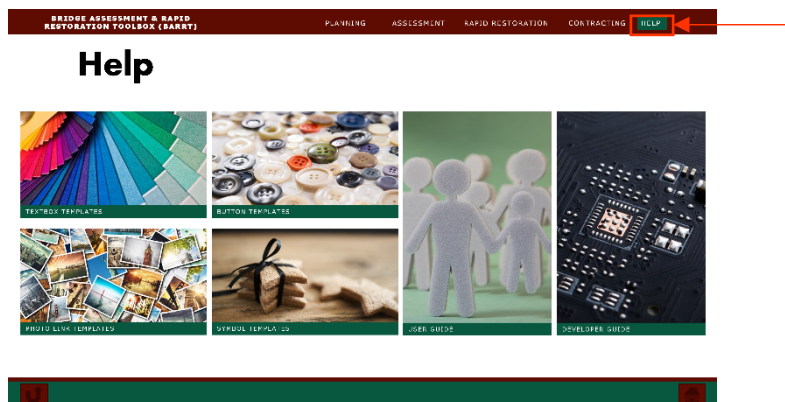
Figure 3-22. Help Section of BARRT

3.6.3 Photos

Similar to textboxes and buttons, one can also add photo heading boxes and other photo links to new or existing slides. To add photo heading boxes, developers navigate to the photo link template slide from the help tab in BARRT or scroll through the slide pane to the photo link template slide. Developers can then make a copy of that template and then copy and paste the desired photo heading box(es) at the appropriate location (Figure 3-24) in the slide.
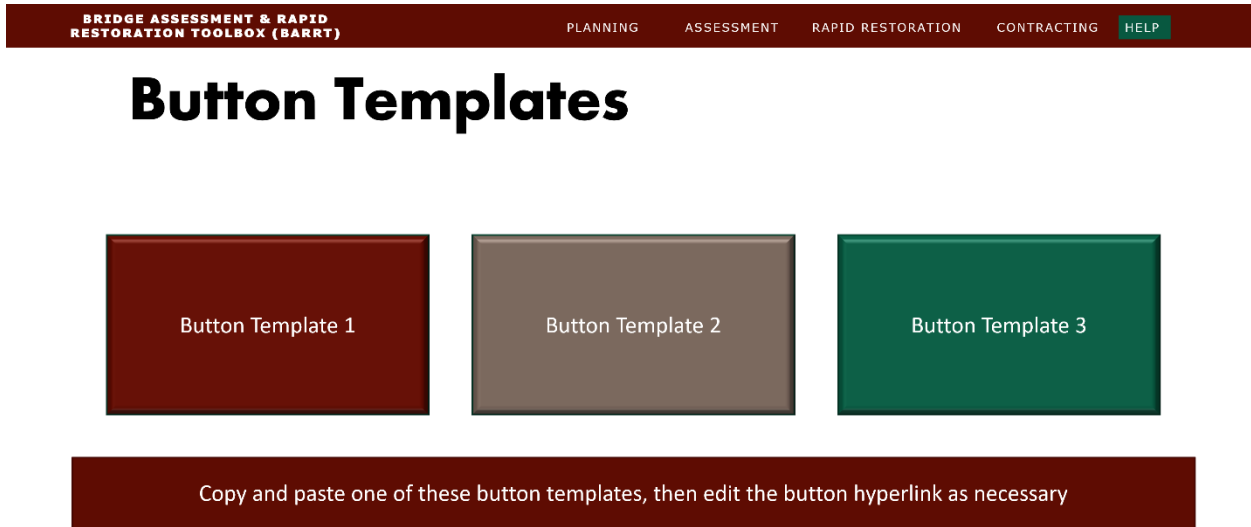
Figure 3-23. Button Template Slide

Figure 3-24. Photo Heading Boxes and Photo Link Template Slides

3.6.4 Symbols

Throughout BARRT, there are a variety of symbols that are used in the bottom navigation bar and to denote multi-page content. To add additional bottom navigation bar symbols (advance to next slide, home, return to previous view, etc.), it is strongly recommended that edits be made to the master slide, as this will propagate changes throughout the entire PowerPoint. One should first open the Slide Master view (see Section 3.5.1), and then navigate to a master slide that has the desired symbol(s). From here, one can select the desired symbol(s) from the bottom navigation bar and copy them. Then, one can create a new master slide by clicking *insert new master slide* in the *master slide* ribbon, then copying and pasting the symbols directly to the slide (Figure 3-25).
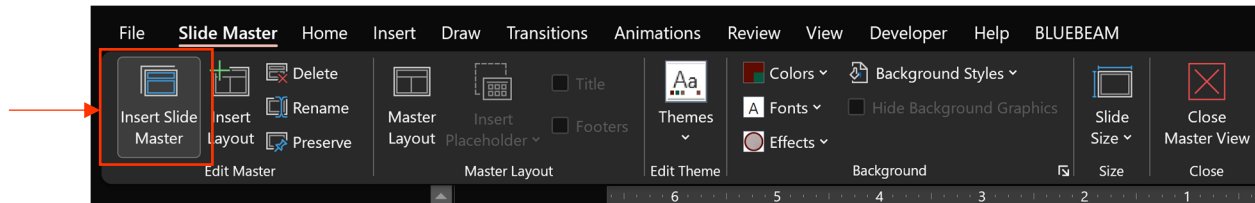
Figure 3-25. Inserting a New Slide Master

This process will automatically align the symbol(s) on the new master slide in the same location as they were on the copied slide. The developer can duplicate existing master slides by right clicking on the master slide and selecting *duplicate* (Figure 3-26). The symbols on that slide will also be duplicated.

However, if one does not want to update all slides and use the Slide Master, they can copy the symbol templates on the *help* ribbon in BARRT, or by scrolling through the slide pane to the *symbol templates* slide (Figure 3-27). From this slide, developers can copy and paste the symbol(s) to the desired location and edit the symbol links.
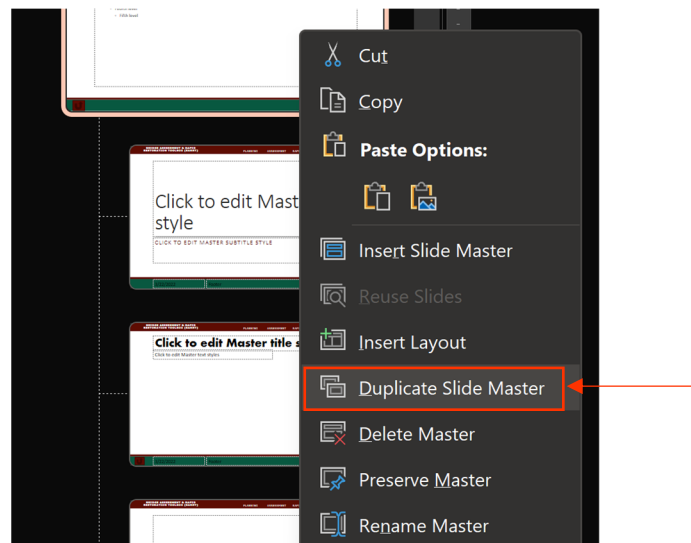
Figure 3-26. Duplicating an Existing Slide Master

To add multi-slide indicators, developers can copy and paste the circle dots on from the *symbol template* slide (Figure 3-27). The circle dots will be automatically pasted into the same location on the new slide as the copied slide. To edit the number of circle dots or to shade in the correct circle to indicate the slide count, developers first need to right click on the circle dots and un-group them (Figure 3-28).
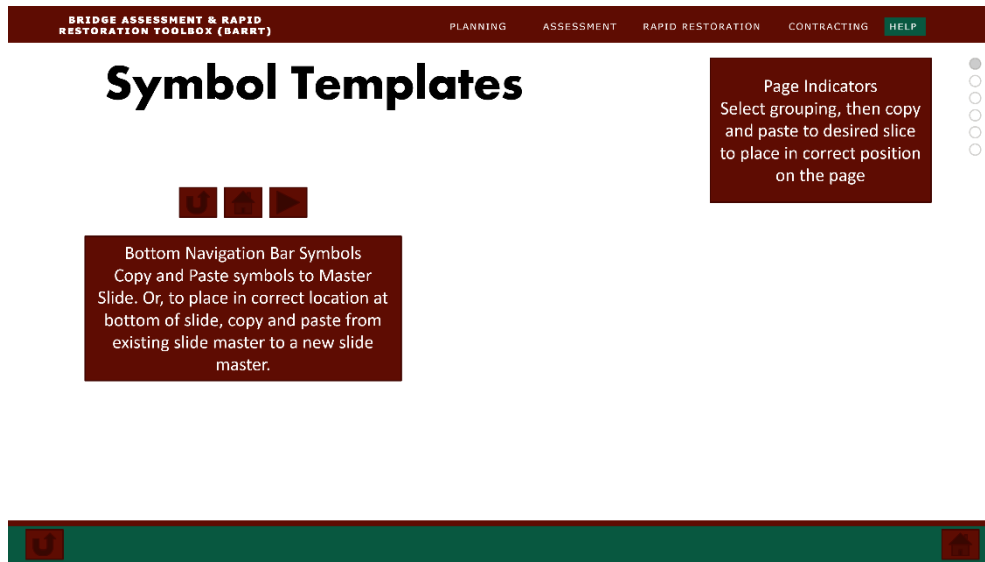
Figure 3-27. Symbol Templates Slide

Once ungrouped, one can delete any unneeded circle dots. To shade in the correct dot, select the top, shaded circle dot and then click on the copy format painter symbol in the *home* ribbon (Figure 3-29).
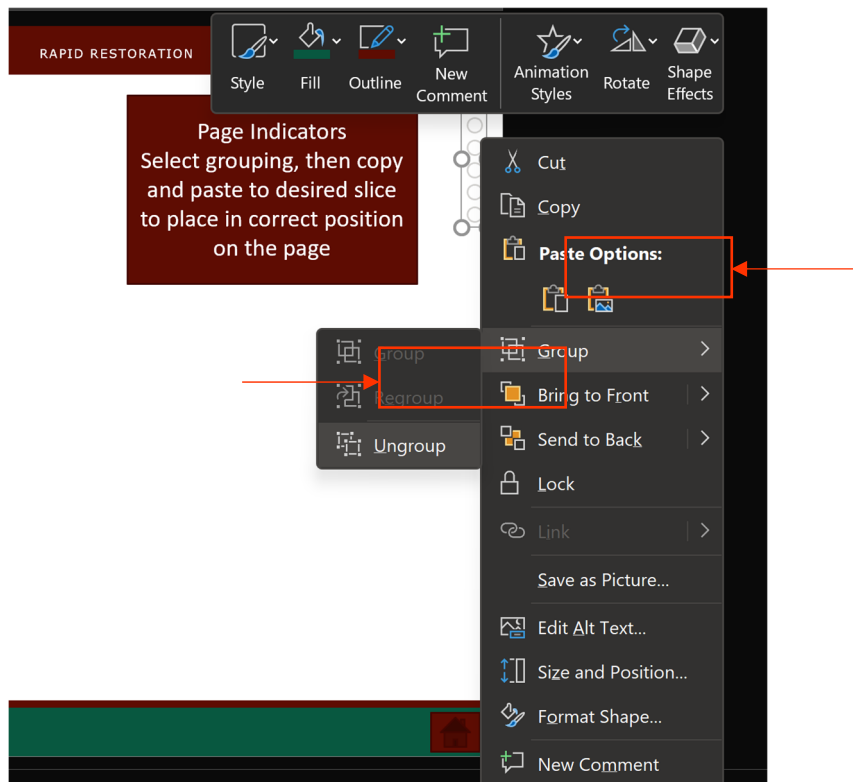
Figure 3-28. Ungrouping Circle Dot Symbols
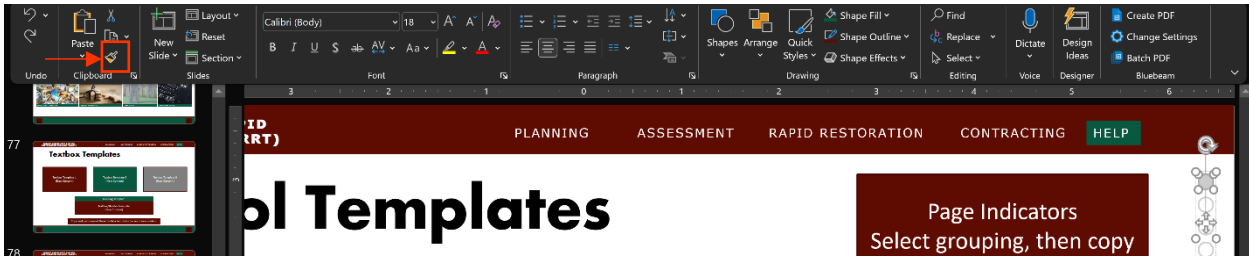
Figure 3-29. Formatting Circle Dot Symbols

Then, click on the circle dot they want shaded, and the formatting will be applied. One can then select an unshaded circle dot and repeat this process to un-shade the first circle dot. Once the formatting is completed, the remaining circle dots can then be selected and re-grouped by either selecting the *group* or *re-group* options (Figure 3-30).
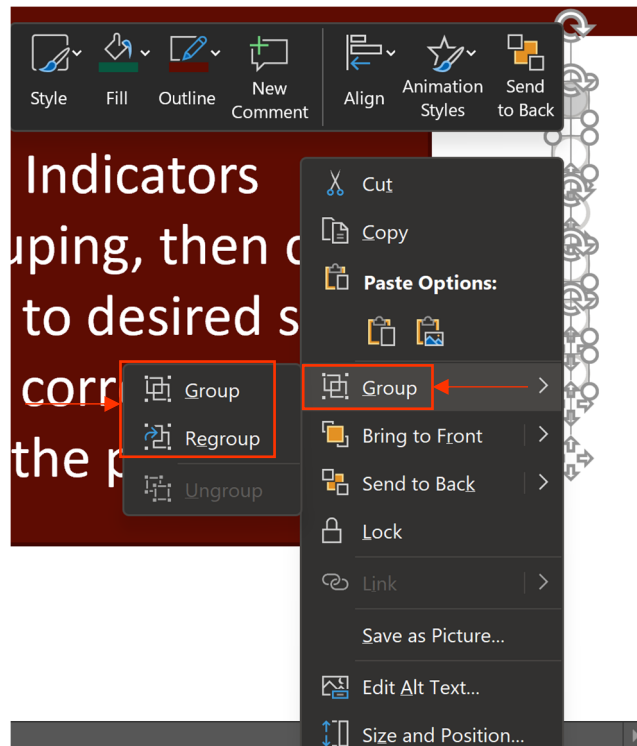
Figure 3-30. Re-grouping the Circle Dots

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3.6.5 Links

To add links to objects, text, and symbols, developers first need to right click on the object they would like to assign the link. Then, developers select *Link* (Figure 3-31).
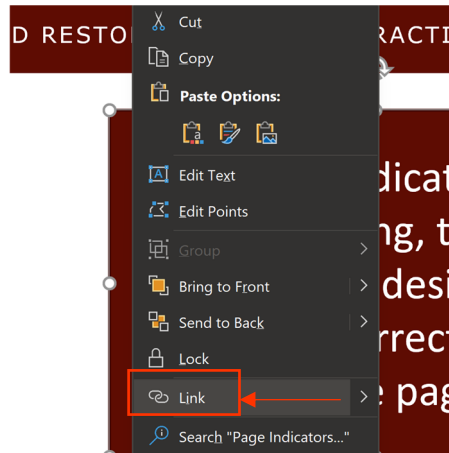
Figure 3-31. Adding a Link to an Object in PowerPoint

Selecting Link opens the edit hyperlink window (Figure 3-32). From this window, developers can select the location of the desired linked file, which could be either a file stored within the **BARRT directory**, or it could be a slide within the BARRT PowerPoint. Developers select their preference from the far-left options, and then use the directory in the middle of the window to make their section. Once completed, developers then click *ok*, and the link has been created.
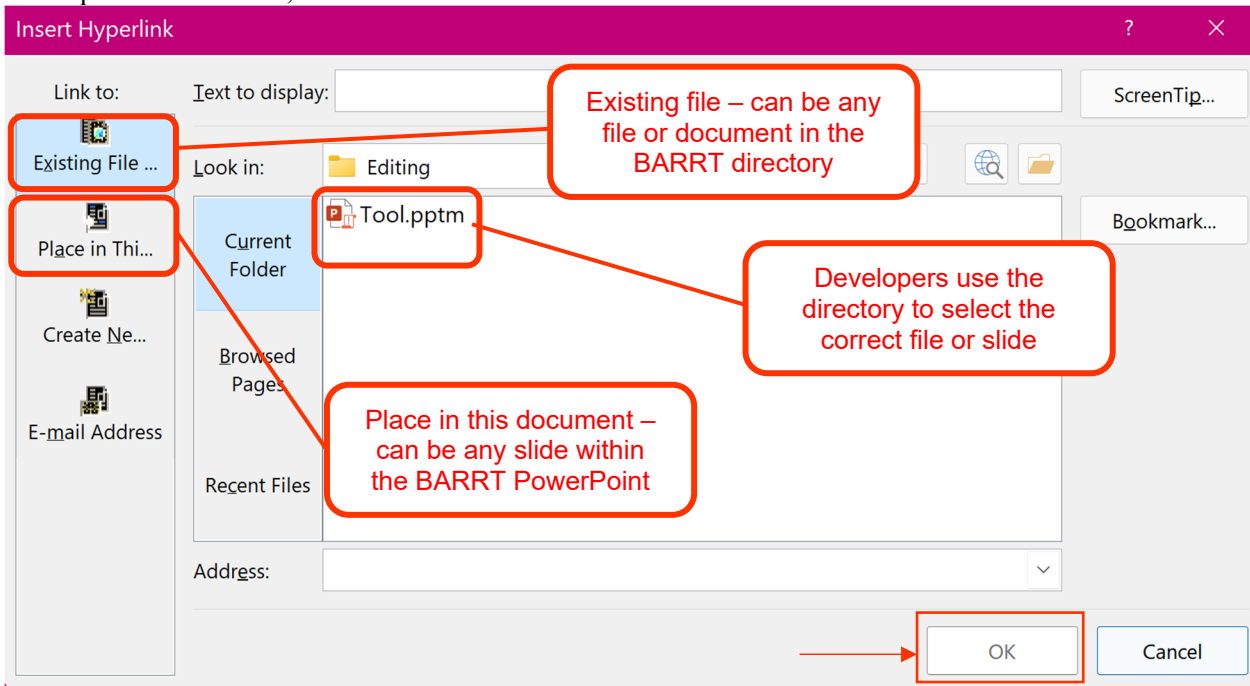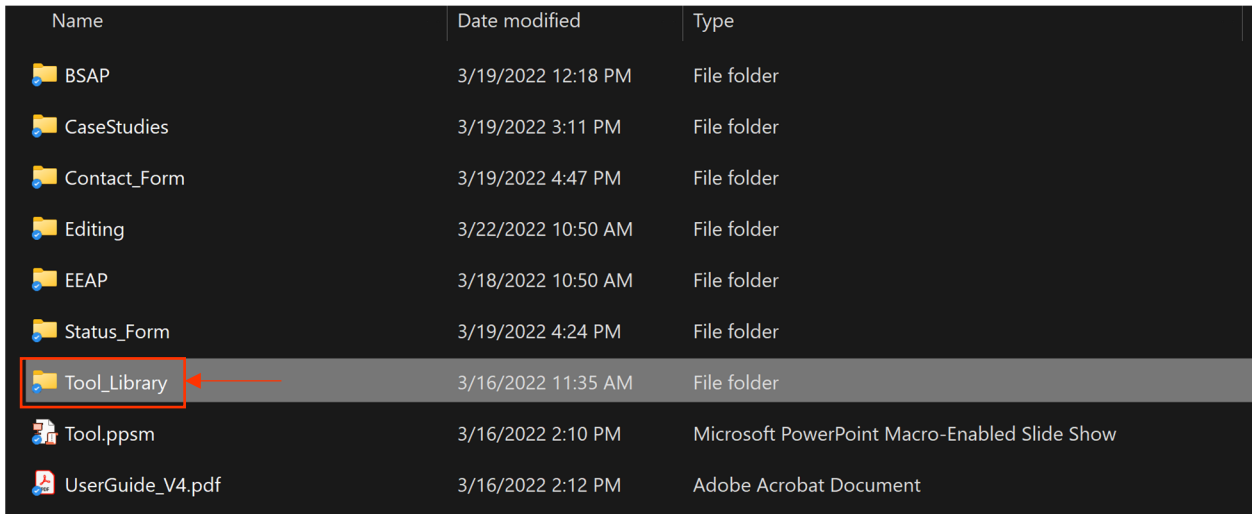
Figure 3-32. Assigning a Link in PowerPoint

3.7 Tool Library

The tool library contains all documents referenced or linked in BARRT. These could be linked via photo heading boxes, linked text, or regularly linked photos. The tool library can be accessed from the **BARRT file directory** for both users and developers. Developers can save new sources to the library by saving PDFs entitled *author_year* or *NCHRP_RPT_number* in the *Tool_Library* folder (Figure 3-33). To link objects (photos, text, buttons, etc.), add the links, and then add the link between the appropriate object and the PDF saved in the tool library.

Name	Date modified	Type
BSAP	3/19/2022 12:18 PM	File folder
CaseStudies	3/19/2022 3:11 PM	File folder
Contact_Form	3/19/2022 4:47 PM	File folder
Editing	3/22/2022 10:50 AM	File folder
EEAP	3/18/2022 10:50 AM	File folder
Status_Form	3/19/2022 4:24 PM	File folder
Tool_Library	3/16/2022 11:35 AM	File folder
Tool.ppsm	3/16/2022 2:10 PM	Microsoft PowerPoint Macro-Enabled Slide Show
UserGuide_V4.pdf	3/16/2022 2:12 PM	Adobe Acrobat Document

Figure 3-33. Opening the Tool Library

Chapter 4: Emergency Event Action Plan (EEAP)

4.1 Overview

The Emergency Event Action Plan (EEAP) provides users with a suggested emergency action plan for their specific extreme event based on the severity of the event. The outputted action plan is a Word document that can quickly be edited, as needed, based on actual conditions before release to get everyone on the same page with the response plan. The user begins with inputting the type of emergency or extreme event, the event location, then indicating the event classification and timeline. With this information, EEAP extracts information from a series of Excel worksheets (hidden within the EEAP Excel Workbook) to generate the Emergency Event Action Plan in Microsoft word (Figure 4-1). Users can customize specific inputs or outputs within the Excel Workbook to reflect their own regional requirements, resources, or practices. Part 2 of the corresponding *Developer's Guide* details this process.

Figure 4-1. EEAP Generation Workflow for Users

4.2 Opening EEAP

EEAP can be accessed through the main interactive PowerPoint format of BARRT (recommended) or through the **file directory**. To open EEAP from the BARRT PowerPoint, users simply click on the *EEAP* button which automatically opens the EEAP tool in Microsoft Excel (Figure 4-2).
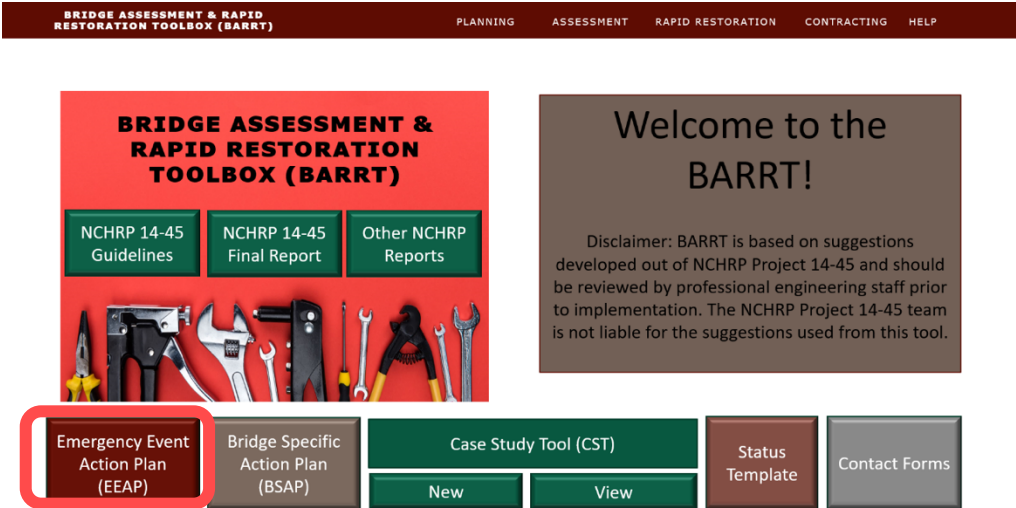
Figure 4-2. Accessing EEAP from BARRT

Alternatively, users can navigate to the **file directory** and click on the **EEAP** folder, which opens the files required to run EEAP. The Excel Workbook entitled **EEAP.xlsm** opens the EEAP Excel Platform (Figure 4-3).
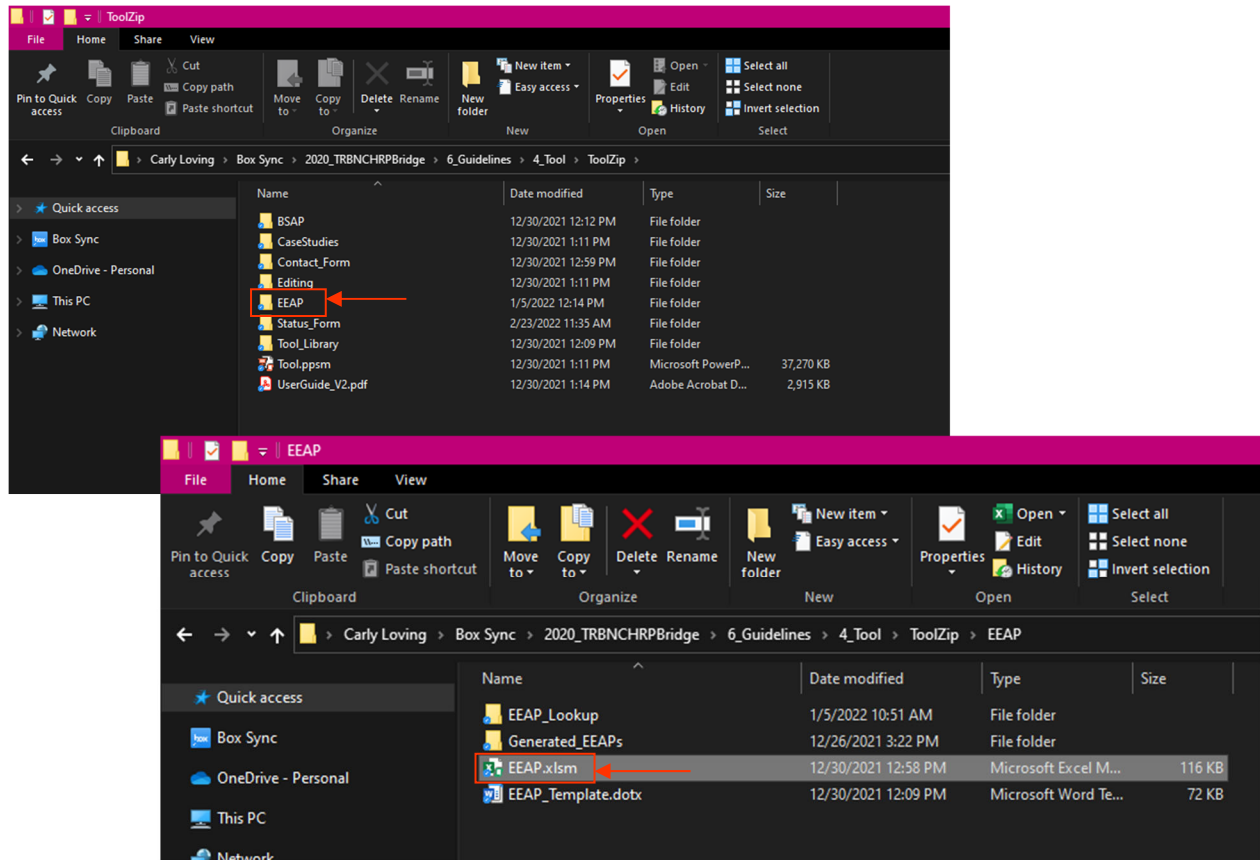
Figure 4-3. Opening EEAP from the File Directory

4.3 How to Use EEAP

From the EEAP home page (Figure 4-4), users input event specific parameters which are used to generate the action plan. These parameters are divided into four subsections: emergency event, location, scope, and event status. Table 4-1 provides more details on these parameters, including how to enter the information, guidance on what information to enter, and examples. Some parameters are event-specific, indicated with a * in Table 4-1. Once users have completed all input fields, users can click the *Generate EEAP* button to produce the EEAP output Word document. A pop-up window will appear once the *Generate* button is selected (Figure 4-5). This prompts users to acknowledge that EEAP is automatically generated and the output should be verified by a qualified professional prior to use. To acknowledge the statement, users click *ok*.

Figure 4-4. EEAP Main Input Form in Excel

Table 4-1. EEAP Input Parameters

Letter	Input	Action	Notes
		Emergency Event	
A	Emergency Event Type	Use the drop-down menu to select applicable event	Events not listed within the drop-down menu are out of the project scope
B	Event Date	Type in the date of which the emergency event occurred	
C	Emergency Event Name	Type in the name of the emergency event	
D	Staff Name	Type in the staff member name completing the form	
E	Staff Title	Type in the title of the staff member completing the form	
F	Organization	Type in the organization of the staff member completing the form	Examples include: Oregon DOT, City of Portland, Washington County
G	Department	Type in the department of the staff member completing the form	Examples include: bridges and structures, maintenance, planning
H	Staff Phone	Type in the phone number of the staff member completing the form	Format: (###) ###-#### With extension: (###) ### - #### - extension
I	Staff Email	Type in the email of the staff member completing the form	
		Location	
J	City	Type in the city where the emergency event occurred	If the event crossed multiple cities, type in the name of the city of interest for EEAP. It is recommended each city has its own EEAP.
K	State	Type in the state where the emergency event occurred	If the event crossed multiple transportation agencies, type in the state that corresponds with the selected city (above)
L	County	Type in the corresponding county of the state selected	If the event crossed multiple counties, include both or pick the one that is most applicable.
M	Region	Type in the region of the responding State DOT	This could be numeric, names, or other labels depending on the State DOT. Put "N/A" if the State DOT does not have specific regions.
		Scope	
N	Seismic Design Category*	Type in the seismic design category for the area of interest	Options are A, B, C, and D. Users must enter either the Seismic Design Category and Magnitude or the MMI to generate EEAP for an earthquake.

Letter	Input	Action	Notes
N	Magnitude*	Type in the magnitude (Mw) of the earthquake	Users must enter either the Seismic Design Category and Magnitude or the MMI to generate EEAP for an earthquake.
N	Modified Mercalli Intensity (MMI)*	Type in the modified Mercalli intensity from the earthquake. Put answer in roman numerals.	Options range from I-X. A description of the MMI scale can be found from the USGS website. Users must enter either the Seismic Design Category and Magnitude or the MMI to generate EEAP for an earthquake.
N	Type*	For tsunamis, type in the type of tsunami, local or distant. For fires, type in the type of fire, wildfire or vehicular.	
N	Flood Stage*	Type in the flood stage: near, minor, moderate, or major	
N	Category*	Type in the category of hurricane: 1, 2, 3, 4, 5	
N	Storm Surge*	Type in the height of the storm surge (predicted or actual) in feet	
N	Number of Impacted Bridges*	Type in the number of bridges that are impacted.	In the case of a wildfire, enter the number of bridges currently impacted or possibly impacted. This input is optional for collisions and vehicular fires.
O	Impact	Click on the button that corresponds to the impact, local or widespread	A hurricane would be widespread, whereas a wildfire may be widespread or local.
Event Status			
P	Event Status	Click on the button that corresponds to the event status that is most applicable	Response would be for an event that is ongoing. Imminent would be for an event that is expected within 1 day. Warning would be an event that is expected within 1-7 days. Training would be for a hypothetical situation.

* Optional Fields
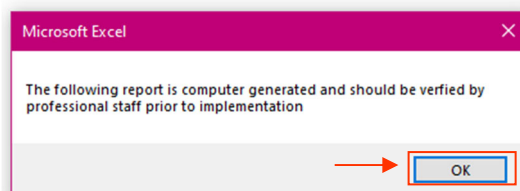
Figure 4-5. User Acknowledgement for EEAP

When EEAP is finished running, a pop-up window will appear to notify users. To acknowledge this pop-up, users click on *ok* (Figure 4-6).
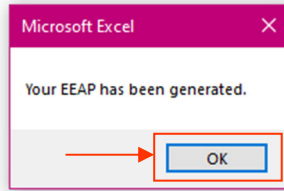
Figure 4-6. Acknowledging Completed EEAP

To open the generated EEAP document, users then click on the *View Generated EEAP* button (Figure 4-7), which opens up the generated Word document.

Figure 4-7. Viewing a Completed EEAP

Depending on the device, Microsoft Word may automatically open on top of the opened EEAP Excel workbook. However, or other devices, Microsoft Word may appear in the Windows taskbar and flash yellow (Figure 4-8). Users click on the flashing Word logo to open the generated EEAP.

Figure 4-8. Flashing Yellow Word Generated Output

To create a new action plan, users return to the Excel spreadsheet and click on the *New Event* button (Figure 4-9), which clears the Excel spreadsheet and permits users to input a new set of information to generate another action plan.
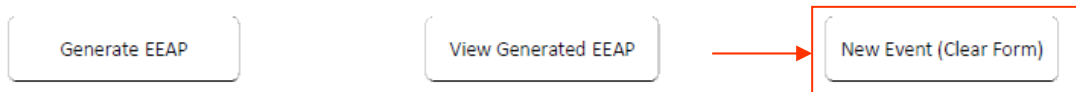
Figure 4-9. Creating a New EEAP Document

4.4 Understanding the EEAP Output

The generated Word document action plan is organized into eight main headings: summary, action, event specific guidance, expected damage, immediate actions, suggested restoration techniques, contracting, and priorities. Each section includes event-specific guidance for users and was developed from research

performed as part of the NCHRP Project 14-45 literature review. Contents of each section is outlined in the following subsections.

4.4.1 Summary

The summary section contains a table summarizing many of the input parameters. The report date is generated automatically, and the response level is assigned based on the inputs. The rest of the tabulated values are based on user inputs. As defined by NCHRP Report 833, the *response level* is an indicator to identify and communicate the required level of resources bases on the event scope (Olsen et al. 2016). There are four main levels (Table 4-2), which can be adapted based on available resources.

Table 4-2. Response Levels (Adapted from Olsen et al. 2016, NCHRP Report 833)

Response Level	Description
I	Regular inspectors in the affected region(s) are placed on call to perform PDAs.
II	Transportation agencies can complete PDAs with their maintenance crews and DDAs with inspection crews
III	Inspectors focus solely on DDAs while maintenance crews, design engineers, and others in the region are immediately mobilized to perform PDAs.
IV	In addition to Level III mobilizations, Transportation agencies can request immediate assistance from inspectors, maintenance crews, design engineers, and external consultants from other regions for assistance.

4.4.2 Response Level Action

This section restates the input parameters of EEAP, including the scope and location. The Response Level is also presented along with general actions based on this response level.

4.4.3 Scope of Concern

The event specific guidance provides general information about the emergency event, such as suggested inspection radii and anticipated collateral damages. This guidance is based on the emergency event type.

4.4.4 Expected Damage

Based on the scope of the emergency event, different magnitudes of expected damage will be generated. Events with higher intensities (greater earthquake magnitude, higher category of storm, etc.) will ordinarily result in more anticipated damages such as a higher likelihood of partial or full collapse. For events with lower intensities, element only level damage is expected.

4.4.5 Immediate Actions

The immediate actions listed are the priority steps that a State DOT should take to prepare or plan for the emergency event response based on information presented in NCHRP Report 833.

4.4.6 Suggested Restoration Techniques

Depending on the response level and the type of emergency event, potential methods for restoration of service methods will be suggested. These methods may include temporary systems such as a Bailey Bridge, detours, and shoring, or permanent solutions such as element repairs and structure replacement. The intent is to provide users with a general understanding of the types of repairs that should be expected for full recovery.

4.4.7 Contracting

The information provided in the contracting section is also based on the response level and type of emergency event. The severity of the situation will trigger different contracting needs, which can vary based on the State DOT's resources. The default information for an agency's in-house capabilities can be easily updated by transportation agencies to better reflect their maturity levels. This section suggests when emergency contracts should be activated as well as when other consultants should be hired for either assessment or repair phases.

4.4.8 Signatures

When EEAP is generated, it is not a legal document; it merely provides suggested repair methods, and engineering staff is still required to read and fully vet the options provided. A reviewer and approver are highly encouraged to read and review the EEAP output to ensure it is appropriate to current conditions. Once approved, the watermark draft can be removed and the document signed, signifying the output has been verified by qualified individuals.

4.5 Viewing Previous EEAPs from the EEAP Directory

Users can view previously generated EEAPs by opening the **EEAP directory** from the **BARRT file directory** (Figure 4-10).
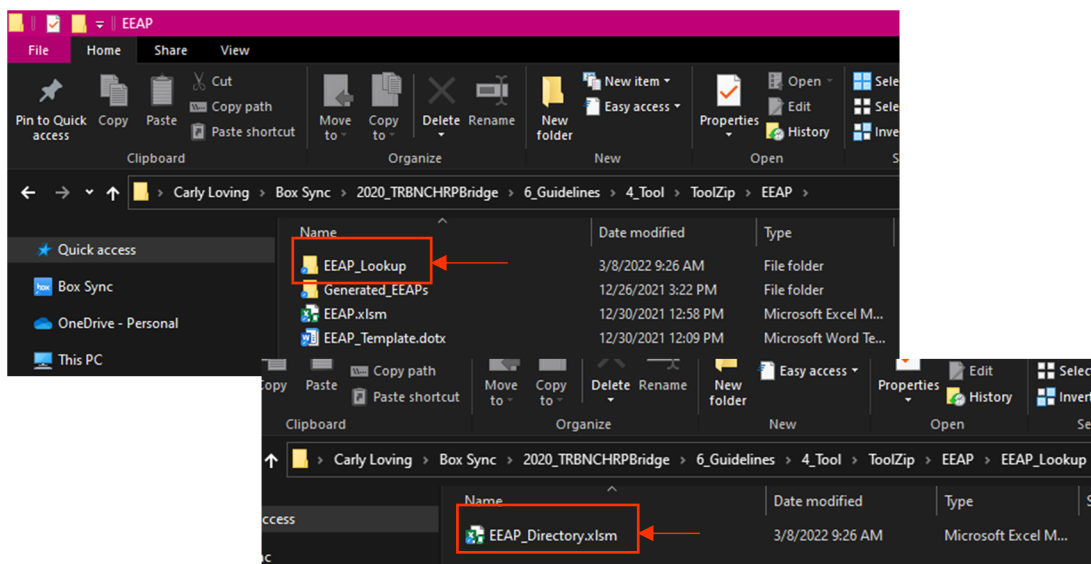
Figure 4-10. Opening the EEAP Directory File

The **EEAP_directory** is an Excel workbook that lists all the previously generated EEAP documents. This workbook is automatically updated each time EEAP is run. From the **EEAP directory**, users can use

the sorting features in Excel to filter the EEAP outputs based on their desired query. Queries can be organized by event name, event type, level of response, date, etc. To filter the data, users first click on the drop-down carrot on the desired column. Then, users select the appropriate checkboxes to filter the entries (Figure 4-11). Once the desired EEAP file(s) is found, users should keep track of the event name and type, as this is how the EEAP files are organized and saved within the directory.
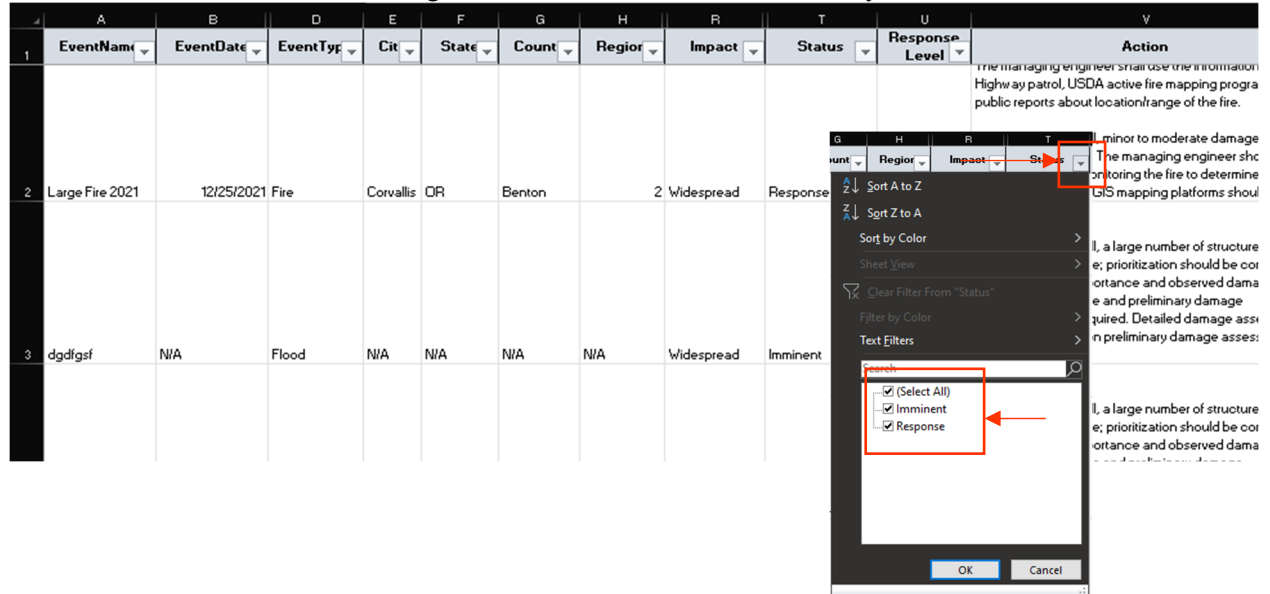
Figure 4-11. Sorting the EEAP Directory

Users can then close the **directory** and open the generated **EEAP** folder from the **file directory** by clicking on the *GeneratedEEAPs* folder and then selecting the name of the EEAP bridge from the listing of generated EEAPs (Figure 4-12).
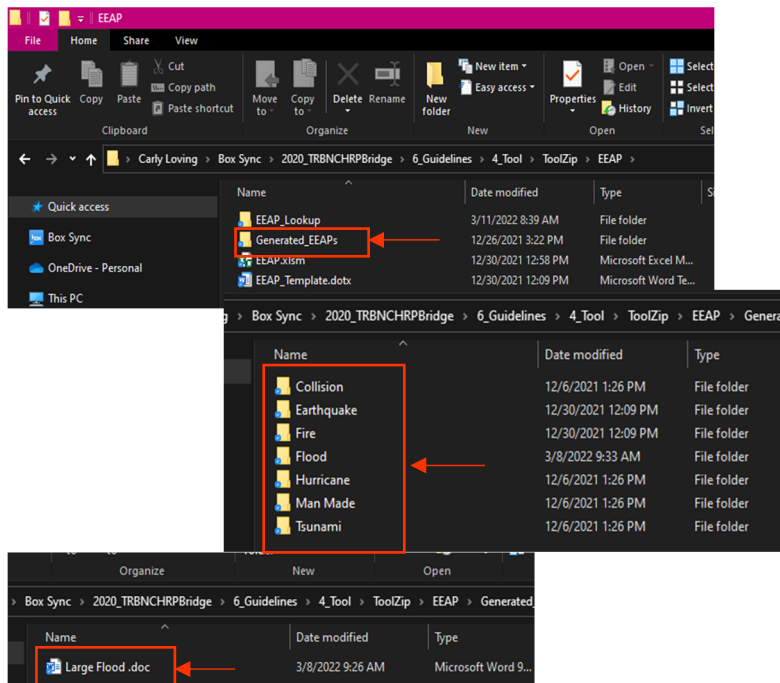
Figure 4-12. Opening Generated EEAPs from a File Directory

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4.6 EEAP User Example

As a demonstration, a hypothetical Magnitude 6.8 earthquake strikes the town of Smallville. The shaking caused the masonry façades on several buildings to crumble to the streets, resulting in an intensity level V. The local State DOT uses EEAP to generate an action plan (Figure 4-13). The resulting EEAP is shown in Figure 4-14 and Figure 4-15.

Figure 4-13. EEAP Input for Magnitude 6.8 Earthquake

Based on the inputs, it is recommended the State DOT mobilizes a Level 4 Response. Widespread damage is anticipated, with the highest levels of damage expected within 80 miles of the epicenter. Transportation agencies should expect a large number of structures to be damaged, and fast reconnaissance and preliminary damage assessments should immediately commence. Detailed damage assessments should be assigned based on preliminary damage assessment findings. It is anticipated that these permanent repairs may include partial or full structure replacement. As necessary, long-term external bridge inspection, repair, and construction contracts should be activated.

EMERGENCY EVENT ACTION PLAN

NOTE: THIS IS AN AUTOGENERATED REPORT AND NEEDS TO BE REVIEWED BY OTHERS PRIOR TO USE.

SUMMARY

REPORT DATE	EVENT NAME		EVENT DATE
1/30/2023	Big Earthquake 2021		9/1/2021
LOCATION	COUNTY		REGION
Smallville, USA	Washington		2
EVENT TYPE	STATUS		RESPONSE LEVEL
Earthquake	Response		IV
STAFF MEMBER NAME		ORGANIZATION/DEPARTMENT	
John Smith, Engineer		DOT, Structures	
STAFF PHONE		STAFF EMAIL	
888-555-1234		johnsmith@dot.gov	

RESPONSE LEVEL ACTION

Response Level IV. Data for this earthquake in Washington County, USA was based on reports from the USGS, including the moment magnitude of 6.8 and moment magnitude intensity of 5. Initial reports indicate that Widespread damage is observed. A large number of structures are subjected to damage, and prioritization should be updated based on bridge importance, especially those that connect lifeline infrastructure, public facilities, and relevant economic activities. Therefore, Fast Reconnaissance and Preliminary Damage Assessments are required. Detailed Damage Assessments are arranged for critical structures.

SCOPE OF CONCERN

The radius of concern for this event is 100 miles.

Note this is an initial inspection radius. If damage is observed outside this radius, the Managing Engineer should order additional Preliminary Damage Assessments.

Figure 4-14. Hypothetical example of EEAP Output for Magnitude 6.8 Earthquake Page 1

   With this information, the local State DOT can begin to mobilize the needed personnel, equipment, and other resources. As needed, they can adapt the EEAP report with updated information. They can also use other features with BAART, such as the Bridge Specific Action Plan (BSAP) once initial assessments are complete and repair methods need to be determined.

EXPECTED DAMAGE

Structural damage, including partial or full collapse, are expected.

IMMEDIATE ACTION

The state's Incident Command System will be activated for this high-level response to ensure coordination of effort among regions, incident command, and other agencies. All available personnel should be mobilized. he Managing Engineer shall utilize all Fast Reconnaissance Methods available to define the scope of concern. Preliminary damage assessments shall be conducted immediately along predefined priority routes. Assessment results, including marking and coding results, are critical for local traffic rerouting and should be updated in real-time.

The Managing Engineer shall arrange for Detailed Damage Assessments of all critical structures that are within the radius of concern as soon as possible. Detailed damage assessments shall be conducted on structures within the geographic scope of concern:
• That was deemed critically important by the managing engineer
• That was marked UNSAFE from preliminary damage assessments
• Where evaluation by a more trained or experienced person is needed

The Managing Engineer updated the structural assessment prioritizations as new information is obtained.

SUGGESTED RESTORATION TECHNIQUES

Element and system-level repairs are expected for impacted bridges. Bridge replacement that align with the bridge owners long term vision should be considered for partially or fully collapsed bridges. Temporary or long-term bridge closures and traffic rerouting are expected. Use the Bridge Specific Action Plan (BSAP) tool for additional repair guidance.

CONTRACTING

Long-term external bridge inspection, repair, and construction contracts are expected. ABC construction should be considered.

SIGNATURES

Revised By	Print Name:	_____	Date:	_____
	Signed Name:	_____	Date:	_____
Approved By	Print Name:	_____	Date:	_____
	Signed Name:	_____	Date:	_____

Page 2

Figure 4-15. Hypothetical example of EEAP Output for a Magnitude 6.8 Earthquake Page 2

4.7 Editing EEAP Excel Workbook Content

4.7.1 Excel Worksheet Database

EEAP provides a recommended action plan draft that includes information for specific actions, anticipated damage, response level, possible restoration techniques, contracting tips, and a list of priorities. The action plan can then be adapted to the specific event and used to guide the emergency response to ensure everyone is on the same page. Within a form page in BARRT, users input the main parameters for EEAP: emergency event type, location, event scope, and event status. With these inputs, EEAP uses search functions to scan the EEAP Excel worksheet database to populate the input parameter selection lists. The EEAP Excel worksheet database consists of nine linked worksheets hidden from view, which contain the different options displayed on the main form page and update automatically based on user inputs.

To edit the content within EEAP, developers first open the EEAP workbook. By default, only the EEAP worksheet is visible. However, all worksheets within the EEAP worksheet may need to be opened, depending the edits required. To open the additional worksheets within the EEAP workbook, developers right click on the EEAP worksheet at the bottom of the workbook and then select *unhide*. A popup window will appear, and developers can select the desired worksheets to unhide, then click *ok* when finished (Figure). To select multiple worksheets, press and hold the *ctrl* button on the keyboard while selecting the worksheets. The content of each worksheet is discussed in the following sections.
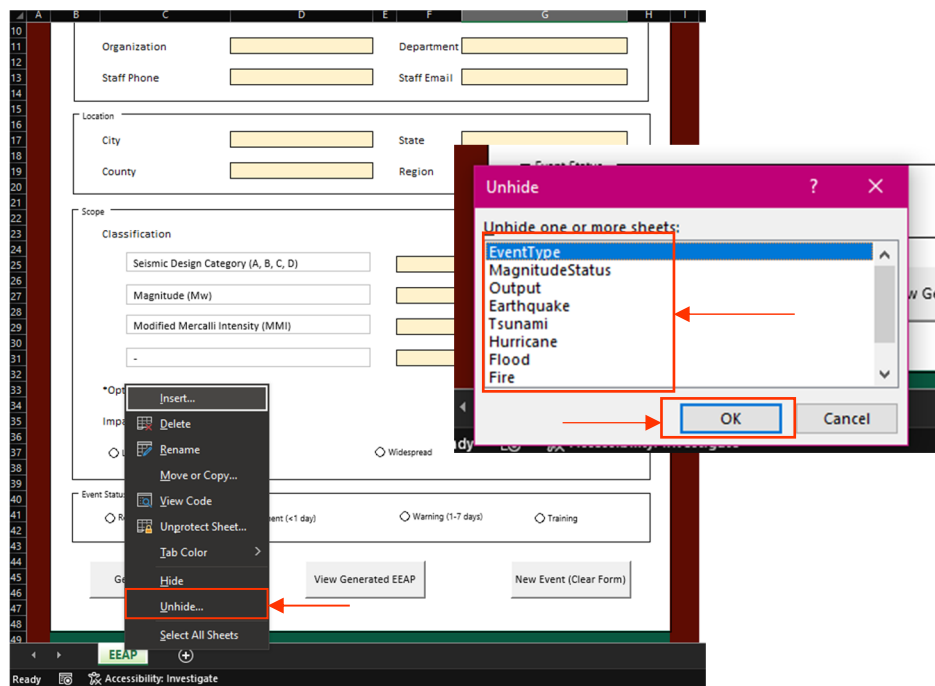
Figure 4-16. Opening a Hidden Worksheet in the EEAP Workbook

Across all worksheets, the green shaded cells are available for editing by developers. The orange shaded regions may still be edited, but would require adjustments to be made to the VBA code. The font size and style does not matter, as the template Word document contains its own formatting.

4.7.1.1 Event Type

The emergency Event Type is the first input users will indicate. This worksheet lists all the possible emergency events that are then displayed to users in the combo box on the EEAP worksheet. These event types can be customized for the state's specific region. For example, State DOTs along the west coast may remove "hurricanes" from the list but add additional information for earthquakes or tsunamis. Depending on the type of emergency event selected, data is pulled from the corresponding worksheets.

The Event Type worksheet also includes the corresponding classifications associated with the event type. These classifications are based on NCHRP Report 833 (Table 4-3). Similar to the event type, these classifications can be modified by State DOTs, as necessary. These classifications are automatically updated on the home page once an emergency event type is selected.

Table 4-3. Categorization of Event Type from NCHRP Report 833 (Olsen et al. 2016)

Event Type	Classification
Fire	Vehicular or Wildfire; Number of Impacted Bridges
Collision	Number of Impacted Bridges
Man Made	Number of Impacted Bridges
Earthquake	Seismic Design Category, Magnitude, Modified Mercalli Intensity
Hurricane	Category and Storm Surge Height
Flood	Flood Stage
Tsunami	Local or Distant, Magnitude, and Modified Mercalli Intensity

Editing

To edit the classifications for a particular event type, developers can edit the orange columns and rows of the Event Type worksheet (Figure 4-17). Developers can also edit the name of the emergency event types. If developers keep edits within the green regions, no edits to the VBA code are required.
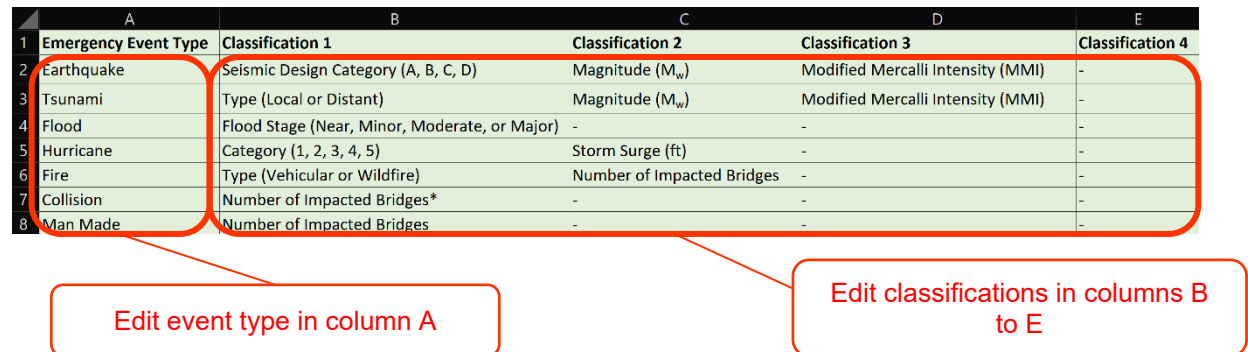
Figure 4-17. Editing Event Type and Classification

The Event Type worksheet edits will automatically update the input parameter lists under scope and classification on the main EEAP worksheet (Figure 4-18).

Figure 4-18. Main EEAP Worksheet Scope Classification

4.7.1.2 Magnitude Status

Overview

The Magnitude Status worksheet information is used to quantify the event impact. Default options are local or widespread, though State DOTs can make alterations as they see fit. This worksheet also contains information about the timing of the event. Some emergency events may have warning, such as a hurricane or flood, whereas others such as a collision or earthquake do not. The status of the event is thus calculated based on the level of advanced warning:

- Response – event is ongoing
- Imminent (<1 day) – short notice of event occurrence
- Warning (1-7 days) – some warning of event, can take more preparatory actions
- Training – hypothetical situation used for planning purposes

The above list are the options presented to users on the EEAP worksheet, and the user selects the one that is the best fit for the agency's current situation.

Editing

To edit the Magnitude Status worksheet, developers can type in the green regions to adjust the impact and to update the status (Figure 4-19).

Figure 4-19. Editing the Impact and Event Status

If developers edit the orange regions, then the VBA code will need to be updated. The number adjacent to the impact and status text help program the radial buttons on the EEAP worksheet (Figure 4-20). In most instances, these numbers do not need to be adjusted.

Figure 4-20. EEAP Worksheet Impact and Event Status Radial Buttons

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4.7.1.3 Event Classification

Overview

There are multiple worksheets that represent Event Classification; there is a worksheet for each event type included within EEAP. These worksheets include the specific details that classify the response level for each type of event. The criteria for each response level are based on the information in NCHRP Report 833. Many of these processes rely on action from the Managing Engineering (ME), who is often a State DOT representative. The following paragraphs provide details about the metrics listed in these worksheets. These thresholds can be customized depending on many factors such as the overall preparedness of the agency and construction techniques.

Fire – Vehicular or Wildfire

Fire events can be classified as a vehicular fire or wildfire. Vehicular fires typically impact only one or a few structures, whereas wildfires can have a widespread impact (Table 4-4) (Olsen et al. 2016). The response level for wildfires is dependent on the number of impacted bridges; the greater the number of the impacted structures, the larger the response. For all vehicular fires, the response level defaults to Level I, but agencies can customize this as necessary.

Table 4-4. Fire Damage Classification (Olsen et al. 2016)

Response Level	Fire Type	Extent of concern	Description of Response
I	Vehicle Fire	Local	ME will deploy PDARs to proceed to the structure and work with fire officials to determine the severity of the fire. During the fire, the structure should be marked as UNSAFE and appropriate traffic control devices should be in place to detour traffic away from the structure. Once the fire event has subsided, proceed to inspect the structure using DDA as much of the damage could be internal and difficult to view during a PDA evaluation.
I-IV	Wildfire	Varies	In the event of a wildfire, ME should work with fire agencies monitoring the fire to determine the extent and severity. GIS mapping platforms should be established and cross-referenced with the fire location in order to determine whether or not the fire will impact any highway structures.
			If the fire does contact any highway structures, physically and digitally mark the structure as UNSAFE and wait until the fire has subsided before proceeding to inspection. Work with Traffic Operations Centers (TOC) to establish alternate routes for the affected structure. It is crucial to establish appropriate traffic control devices to detour the public away from the structure. Because fire damage is variable in nature, DDA procedures should be used instead of PDA.
			As the size of the fire increases from local to statewide, continue to monitor all structures within the affected range. Increase the number of personnel and inspectors appropriately.

Editing Fire – Vehicular or Wildfire

Developers can edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns D to I) on the Fire worksheet. This is the worksheet that is used to generate the Word document output when fire is selected as the event type on the input worksheet.

To edit the metrics used for the assigned response level, developers can adjust the specified range for number of bridges in columns A and B (Figure 4-21, green regions). It is recommended that developers edit only columns A and B for this purpose and not column C. For a vehicular fire, only one response level is included; if multiple response levels are desired, developers will need to edit the VBA code (Figure 4-21, red regions).

Figure 4-21. Editable (Green) Regions for Wildfires

For wildfires, if the edits are kept within columns A and B plus D through I and rows 11 to 14, no adjustments to the VBA code are needed (Figure 4-22 green regions).

Figure 4-22. Editable (Green) Regions for Vehicular Fires. Image shown is only a sample, see the EEAP Excel Workbook for the full content.

Collision– Number of Impacted Bridges

For collisions, the number of impacted structure(s) determines the appropriate classification. Typically, only one bridge or culvert is affected, so the response is usually a Level I. However, agencies can customize this to increase the response to higher levels if deemed appropriate; thus, the number of impacted bridges is optional for collisions.

Editing Collision – Number of Impacted Bridged

Similar to vehicular fire*s*, there is only one response level pre-coded with the VBA code for collisions. If developers want to add additional response levels, the VBA code will need to be modified. Developers can edit the response level actions, event specific guidance, expected damage, immediate action, restoration

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techniques, and contracting dialogue by typing in the corresponding cell (columns A and B plus D to I) on the Collision worksheet for row 3 (Figure 4-23 green regions).

Figure 4-23. Editable (Green) Regions for Collisions

Man Made– Number of Impacted Bridges

For man-made events, the number of impacted structure(s) determines the appropriate classification. Typically, only one bridge or culvert is affected, so the response is usually a Level I. However, for coordinated attacks or major vehicular pileups, multiple structures could be damaged, which could trigger a Level II or greater response.

Editing Man Made – Number of Impacted Bridges

To edit the metrics used for categorizing the response levels, developers either alter the ranges listed for the number of impacted bridges (columns A and B green regions, Figure 4-24).

Figure 4-24. Editing the Metric Range Number of Impact Bridges

Developers can edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns D to I green regions) on the Man-Made worksheet. If edits are made outside this range (Figure 4-25), then edits to the VBA will need to be made.

Figure 4-25. Editing the Response Level Actions, Expected Damages, Immediate Action, Restoration Techniques, and Contracting Methods.

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Earthquake – Magnitude and Modified Mercalli Intensity

For earthquakes, magnitude and epicenter distance are typical methods for estimated potential damage and determining the appropriate response level. These magnitudes can be further refined by considering the seismic design categories of a bridge (Table 4-5) (Olsen et al. 2016). Most State DOTs use some form of magnitude classification to mobilize inspection teams and establish command centers.

Table 4-5. Earthquake Classification Magnitude (Olsen et al. 2016)

Response Level	Earthquake Magnitude		Radius of Concern	Description of Response
	SDC A/B	SDC C/D		
I	Mw < 3.5	Mw ≤ 5.5	N/A	A broad-based response is not planned or required. If there are reports of damage, the ME will determine if a PDA needs to be done. ME uses discretion to inspect especially vulnerable or critical structures close to the epicenter.
II	3.5 ≤ Mw < 4.5	5.5 < Mw < 6.2	40 mi	ME will immediately initiate PDA. All state routes within the residency will be driven according to priority and all structures investigated. Reports of damage or questionable conditions will be called in immediately. Summary reports are to be sent to the ME at the end of each day. If no damage is discovered during PDA, the post-earthquake response can be terminated. DDA will be done on structures within the radius of concern: Deemed critically important by the ME Following an UNSAFE rating from PDA Where evaluation by a more trained or experienced person is needed If there are reports of structural damage outside of the default radius of concern, the ME will increase the radius and adjust the inspection program accordingly.
III	4.5 ≤ Mw < 5.5	6.2 ≤ Mw < 6.7	60 mi	Use the same criteria as Response Level II, but with a larger radius.
IV (High)	Mw ≥ 5.5	Mw ≥ 6.7	80+ mi	The State's Incident Command System (ICS) will be activated for this High-Level Response to ensure coordination of effort among SHA Regions, Main Office, and other agencies. All available personnel should be mobilized. PDARs will conduct PDA of routes immediately and ME will arrange for DDA of all critical structures that are within the radius of concern as soon as possible. DDA evaluations should also follow the same criteria presented in Response Level II.

As an alternative to Magnitude, Modified Mercalli Intensity (MMI) is based on observed damages. This intensity represents the actual effects experienced at a particular region during the seismic event, which translate to an easier-to-understand measurement of the earthquake damages (Table 4-6).

Table 4-6. Earthquake Classification MMI (USGS 2021)

MMI	Shaking	Description
I	Not felt	Not felt
II	Weak	Felt by a few, especially on upper floors of buildings
III	Weak	Felt by several; vibration like the passing of a truck. Most do not recognize it as an earthquake.
IV	Light	Felt by many indoors, less outdoors; sensation like heavy body striking a building. Dishes, doors, windows are disturbed. Walls make cracking sounds.
V	Moderate	Felt by nearly all; frightens a few. Awakens most during the night. Some windows broken, unstable objects overturned, pendulum clocks may stop working.
VI	Strong	Frights many; people move unsteadily. Some heavy furniture moved, slight damage overall.
VII	Very Strong	Frightens most; some lose balance. Considerable damage for poorly built structures, some damage to ordinary structures, and damage slight in seismically designed structures. Some chimneys broken.
VIII	Severe	Many find it difficult to stand. Great damage in poorly build structures, considerable damaged to ordinary structures, slight damage to seismically designed structures. Heavy furniture overturned, collapsed of monuments, walls, chimneys, etc.
IX	Violent	Some forcibly thrown to the ground. Damage considerable in seismically designed structures. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry/frame structures destroyed. Rails bent.

Editing Earthquake – Magnitude and Modified Mercalli Intensity

To edit the metrics used for categorizing the response levels, developers either alter the ranges listed for the earthquake magnitude (columns A and B, green region) or MMI (columns K and L, green region). The ranges can be edited by typing in the desired magnitude or MMI value (Figure 4-26). The magnitude and MMI ranges can be edited for all four seismic design categories.

(a)   *(b)*
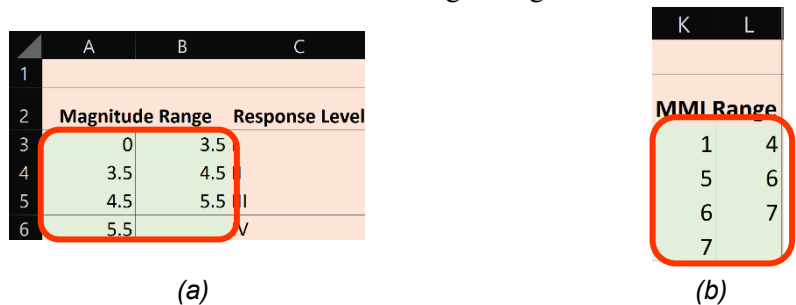
Figure 4-26. Editing the Metric Range for (a) Magnitude or (b) MMI

Developers can also edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns D to I, green regions) on the Earthquake worksheet for each combination of seismic design category, magnitude, and MMI (Figure 4-27). Columns M and N are used to concatenate the action output for the generated EEAP Word document. If these columns are edited, the VBA code will need extensive revisions (red regions).

Figure 4-27. Editable (green) Regions for Earthquakes without Adjusting VBA Code

Hurricane – Category and Storm Surge Height

For hurricanes, State DOTs typically use categories to determine the required level of response. Corresponding storm surge heights can be used to refine response levels (Table 4-7 and Table 4-8).

Table 4-7. Hurricane Classification (Olsen et al. 2016)

Response Level	Wind Speed (mph) (scale)	Extent of Concern	Description of Response
I	74 – 95 mph (Hurricane Category 1)	Local	ME will monitor the development, progress, and location of the hurricane. ME will initiate PDA evaluation of all highway structures within the hurricane warning area. State DOTs affected should work in conjunction providing resources and personnel to any State DOTs in need.
II	96 – 110 mph (Hurricane Category 2)	Regional	Prior to the hurricane contacting land, the ME should develop a list of critical highway structures within the defined hurricane warning area. As the hurricane develops, wind speeds should be collected and reference with highway structures.
III	111 – 155 mph (Hurricane Category 3-4)	Statewide	As the intensity of the hurricane increases to hurricane category 3, a wider inspection radius should be used compared with Response Level II. This response level will follow the same criteria as Response Level II but with a larger radius. In the event of a widespread event, SHAs should request federal assistance for inspections.
IV (High)	> 156 mph (Hurricane Category 5)	Multiple transportation agencies	In the event of a category 4 or 5 hurricane, all SHAs affected should work in conjunction with federal agencies for necessary assistance. This event will likely be widespread and tax the resources and personnel of the local agencies in charge of structure assessment. It is recommended that a detailed FR be performed in order to estimate the geographical extent of damage. Highway structure locations should be monitored with wind speeds.

Table 4-8. Storm Surge Classification (Olsen et al. 2016)

Response Level	Storm Surge Height	Description of Response
I	< 5 feet	ME will monitor the development, progress, and location of storm surge heights. Storm surge maps should be developed highlighted areas of prolonged exposure to storm surge wave loading. ME will initiate PDA of all highway structures along the affected coastline. Embankments are particularly vulnerable to erosion. Regarding bridges, inspect all bridges that have storm surge heights that meet or exceed the designated design water level using DDA. State DOTs affected should work in conjunction providing resources and personnel to any State DOTs in need.
II	6 – 8 feet	Storm surge heights should be collected and referenced with highway structures. All areas of coastline affected by storm surge should be evaluated using PDA.
III	9 – 12 feet	As the storm surge height increases, the extent of damage is likely going to increase along the coast. This response level will follow the same criteria as Response Level II but with a larger radius.
IV (High)	> 13 feet	In the event of any storm surge heights over 13 feet, State DOTs should work in with federal agencies for assistance. Storm surge levels will likely impact large areas of coastline and cause extensive damage that could tax the resources and personnel of the local agencies in charge of structure assessment. It is recommended that detailed FR be performed to estimate the geographical extent of damage. Highway structure locations should be monitored with storm surge heights. In any case when storm surge heights exceed the structure height, these structures should be evaluated using DDA. Any structure affected by storm surge should be evaluated using PDA.

Editing Hurricane – Category and Storm Surge Height

The hurricane category and storm surge metrics used to assign the response levels for hurricanes can be edited by adjusting the values listed in Columns A through D (Figure 4-28, green regions). It is strongly recommended that instead of editing column E, alter these first four columns to adjust the metrics.

Figure 4-28. Editing the Response Level Metrics for Storm Surge and Category

Developers can also edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns D to I) on the Hurricane worksheet without adjusting the VBA code (Figure 4-29).

Only edit the content in the green regions
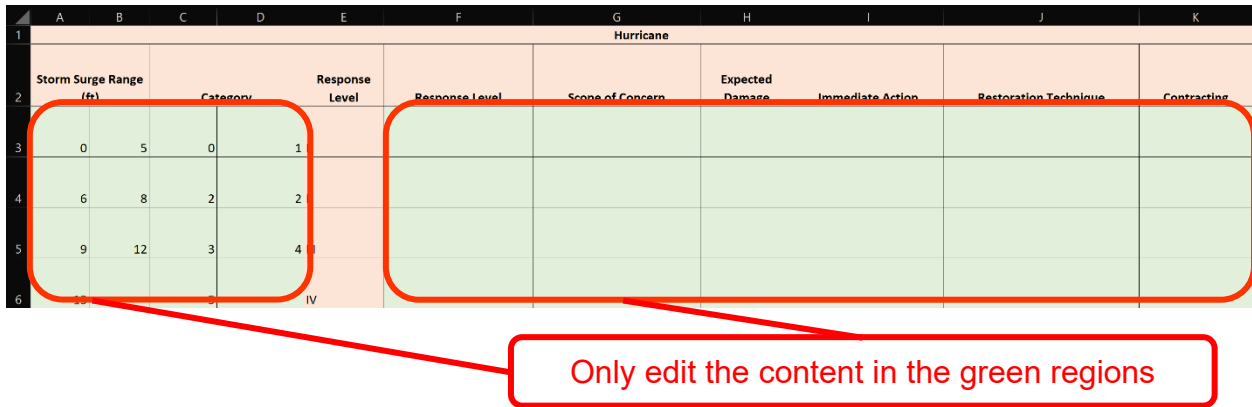
Figure 4-29. Editable (green) Regions for Hurricane without Adjusting VBA Code

Flood – Flood Stage

For floods, river flooding is monitored by the National Weather Service (NWS) and provides maps and warnings based on river flooding levels (Table 4-9).

Table 4-9. Flood Classification (Olsen et al. 2016)

Response Level	River Flooding	Extent of Concern	Description of Response
I	Near Flood Stage	N/A	ME will monitor and track scour critical structures. Highway structure elevations should be mapped and cross-referenced with flood maps in order to estimate the likelihood of flooding near or on any highway structure. It is not necessary to perform PDA evaluations at this time.
II	Minor Flooding (5–10-year recurrence)	Contained to rivers	Highway structures partially inundated should be assessed and evaluated using PDA. If conditions are suitable, PDA may be performed during flooding scenarios. If flooding conditions are not suitable, PDA should be performed immediately following the flooding event. Scour critical bridges and culverts should be monitored and evaluated using DDA.
III	Moderate Flooding (15–40-year recurrence)	Rivers and close roads	In the event of moderate flooding, the geographical extent may span over several miles. All available SHA personnel and resources should be deployed in order to adequately assess the extent of damage due to flooding. Highway structures that were previously scour critical should be evaluated using DDA. All other highway structures with unknown scour information should be evaluated using PDA.
IV (High)	Major Flooding (50–100-year recurrence)	Determined by severity. Likely wide-spread	Major flooding events will likely tax the resources and personnel of the SHA. When there is a lack of personnel and resources, ME should request federal assistance. All highway structures that were considered scour critical prior to flooding should be evaluated using DDA. All other highway structures should be evaluated using PDA.

To edit the metrics used for categorizing the response levels, developers alter the ranges listed for the flood magnitude (Column A, green regions) to other delineations for the agency (Figure 4-30).

Figure 4-30. Editing the Response Level Metrics for Flood Magnitude

Developers can also edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns C to I, green regions) on the Flood worksheet without adjusting the VBA code (Figure 4-31). Column J is used to concatenate the action output for the generated EEAP Word document, so it is important these columns are not edited. If they are, the VBA code will need extensive revisions.

Figure 4-31. Editable Regions for Flood without Adjusting VBA Code

Tsunami – Local or Distant

Tsunamis can be generated from local or distant origins. Local tsunamis only take minutes to reach the shore, giving little to no warning. These tsunamis are often the most devastating, and response levels will be heavily focused on search and rescue. Distant tsunamis travel great distances across oceans, and often provide some warning. These tsunamis can be just as devastating to infrastructure, but loss of life can be reduced due to the alert. NOAA also includes earthquake magnitude to help determine the threat of a tsunami (method used in Hawaii) (Table 4-10) (Olsen et al. 2016).

Editing Tsunami – Local or Distant

To edit the metrics used for categorizing the response levels, developers either alter the ranges listed for the earthquake magnitude or MMI (Figure 4-32). Developers can also edit the response level actions, event specific guidance, expected damage, immediate action, restoration techniques, and contracting dialogue by typing in the corresponding cell (columns D to I) on the Tsunami worksheet without adjusting the VBA code (Figure 4-33).

Table 4-10. Tsunami Classification (Olsen et al. 2016)

Response Level	Event and Message Type	Earthquake Magnitude	Tsunami Amplitude	Description of Response
I	Local (Local Tsunami Information)	4.0 – 6.8	< 4 inches	ME will monitor any cases of tsunamis reaching shorelines within the messages provided by NOAA. In the event of a tsunami, ME will initiate inspection highway structure using PDA based on inundation levels. If it is confirmed that there is no tsunami reaching onshore, no highway structures need to be inspected.
	Distant (Tsunami Information)	6.5 – 7.8		
II	Local (Local Tsunami Information)	4.0 – 6.8	4 inches – 3 feet	NOAA warning messages will provide the location, coordinates, and arrival time of the estimated tsunami wave. Once a tsunami warning is issued, ME should plan PDA routes in the affected area. If there is confirmation that a region was hit by a tsunami, and only after the tsunami warning has been listed, ME will initiate PDA of highway structures. If no damage is discovered during PDA, the response can be terminated. As the inundation decreases from the coastline, structures should be evaluated based on the discretion of the ME. In events of prolonged flooding, structures should be evaluated.
	Distant (Tsunami Advisory)	≥ 7.9 and ETA > 6 hours		
III	Local (Urgent Local Tsunami Warning)	6.9 – 7.5	3 feet – 10 feet	ME will monitor NOAA messages for the tsunami locations and arrival times. Inspections should only begin after the tsunami draw down subsides. Tsunamis of this intensity are expected to occur over a vast area of coastline. SHAs may or may not have the personnel and resources to perform structural assessments. If there is a lack of resources, SHAs should request assistance from federal agencies. Highway structures may not only have damage from the initial tsunami impact, but also the drawdown of the wave. Geotechnical and structural damage should be assessed using PDA of all highway structures located within the inundation zone.
	Distant (Tsunami Watch)	≥ 7.9 and ETA 3-6 hours		
IV (High)	Local (Statewide Urgent Local Tsunami Warning)	≥ 7.6*	> 10 feet	ME will verify affected coastal regions within NOAA messages. Detailed FR will take place to estimate the geographical extent of damage. All regions involved will activate the ICS to ensure coordination with federal agencies. This event will require all available SHA inspectors, personnel, and resources.

(a)   *(b)*

Figure 4-32. Editing the Metric Range for (a) Magnitude or (b) MMI

Only edit the content in the green regions

Figure 4-33. Editable (green) Regions for Tsunami without Adjusting VBA Code

4.7.1.4 Output

Overview

The Output worksheet records all the inputs collected on the EEAP worksheet, including the location, staff contacts, and the other parameters described on the other worksheets. The Output worksheet copies the pertinent event-specific data from the appropriate worksheets The VBA code uses the Output worksheet to generate the Word document output from the template as well as generate the EEAP directory structure.

Editing

Unless developers need to update the VBA code for any event specific worksheets, there is no need to update the Output worksheet.

Output Generation

With all the inputs, the code pulls the information from the Output worksheet to fill in the placeholders of the template document (Figure 4-34 and Figure 4-35). The template can be modified by State DOTs as needed; however, the corresponding code will also need to be edited if specific aspects of the template is altered.

The EEAP file is generated using a series of find and replace commands with the template. In the corresponding section of the template, the specific placeholder is searched and replaced with the text in the Output worksheet in Excel. The code runs through all the placeholders in the document, then saves the file as a Word document in the subfolder that corresponds to the event type. During this process, the information on the Output worksheet in Excel is also copied to the EEAP directory. The EEAP directory can be accessed directly from the **BARRT file directory**. The EEAP directory allows users to search for past generated EEAPs, and filter documents by event type, response level, actions, and other information using the filter

feature in Excel. To view the desired EEAP, users can use the event type and name to then navigate through the **file directory** to look for the output of interest.

Figure 4-34. EEAP Template Page 1

Figure 4-35. EEAP Template Page 2

4.8 Editing EEAP Word Document Template

The Word template (Figure 4-34 and Figure 4-35) that EEAP uses to generate the Word document output can be edited to meet an agency's needs. To edit the template, developers can open the Word template from the **EEAP file directory** by double clicking on **EEAP_Template.dotx** (Figure 4-36).
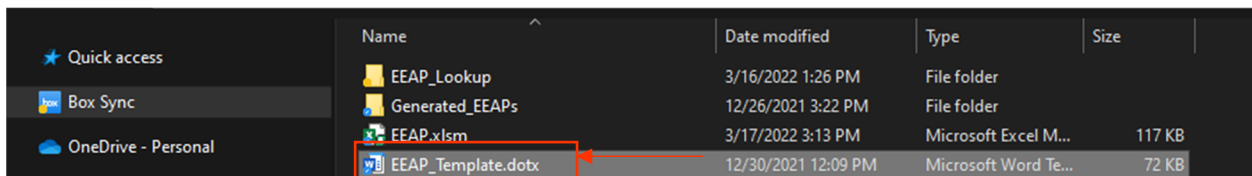
Figure 4-36. Opening EEAP Word Template from EEAP File Directory

With the template opens, developers can edit any of the text that does not have a "#" in front of it. The "#" symbol is used by the VBA code to copy the data from the Output worksheet of the EEAP Workbook and paste it into the Word document. The formatting of the table and the headings can be altered as long as the "#" text remains the same. Otherwise, the VBA code will need to be adjusted.

Once the desired formatting and text is updated in the template, developers will need to save the template as a new template by going to the *file* tab and clicking *save as* (Figure 4-37), then clicking *browse,* and navigating to the **EEAP file directory**.
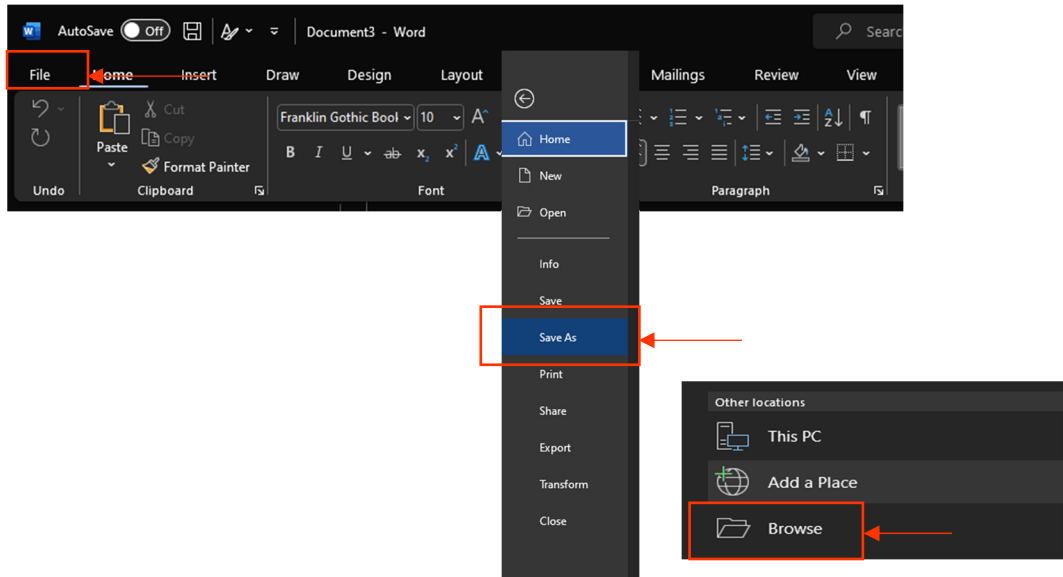
Figure 4-37. Saving the Updated Word Template via "Save As"

The name of the template needs to be entered as: **EEAP_Template1.dotx**. The file name cannot be **EEAP_Template.dotx** as that is the name of the original template, and Microsoft Word is unable to overwrite this existing file in this case. The file type also needs to be changed to a *Word Template (*.dotx)* from the drop-down menu under *save as type* (Figure 4-38). Lastly, the document can be saved by clicking *save* (Figure 4-39).
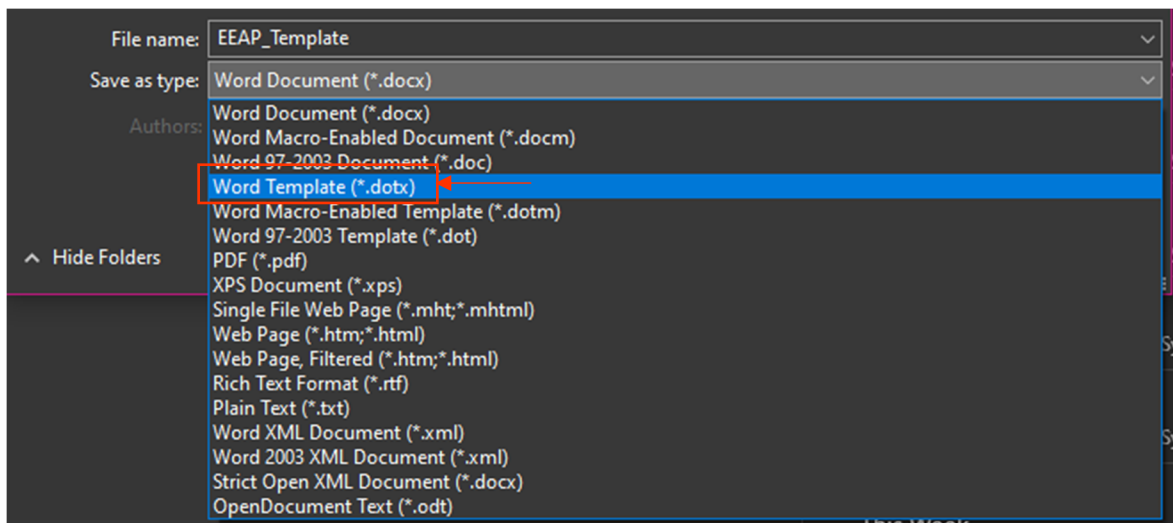
Figure 4-38. Changing the File Type to a Word Template
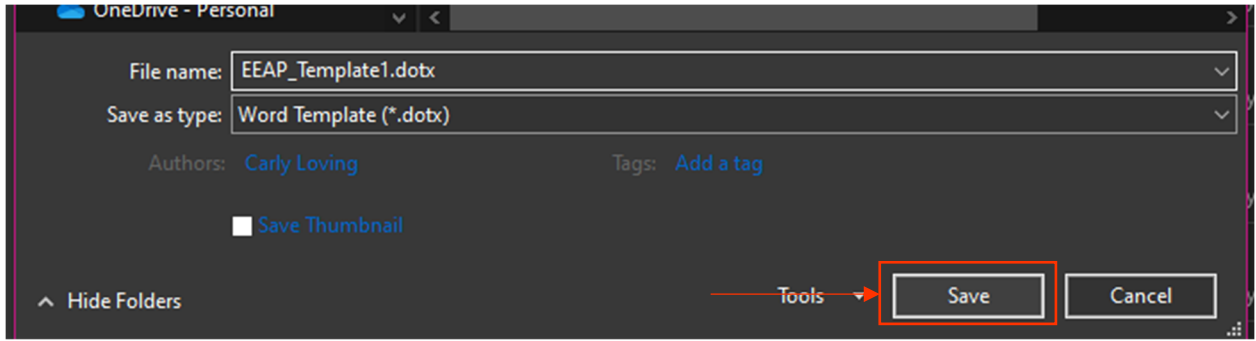
Figure 4-39. Saving the Edited EEAP Template File as "EEAP_Template1.dotx"

From the **EEAP file directory**, the original **EEAP_Template.dotx** file can now be deleted, and the newly created **EEAP_Template1.dotx** file must be renamed to **EEAP_Template.dotx**, which is the name expected by the VBA code. To rename the template, developers right click on the file, select rename, and remove the *1* in the file name (Figure 4-40). This completes the procedure for editing the Word template.
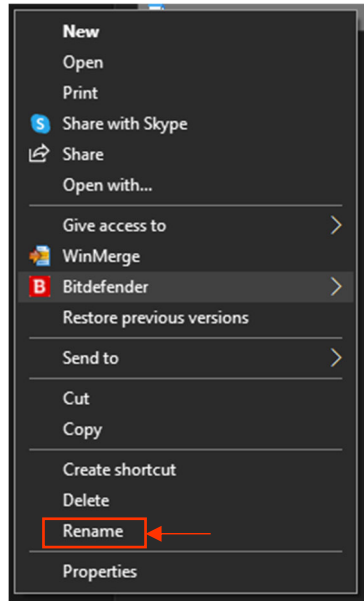
Figure 4-40. Renaming the Template File Name by Right-Clicking and Selecting "Rename"

Chapter 5: Bridge Specific Action Plan (BSAP)

5.1 Overview

The Bridge Specific Action Plan (BSAP) provides users with a suggested action plan and possible reapir solutions based on the observed damage to the bridge. The observed damage inputs align with the MBEI elements and defects and include bridge type, element number, defect, and keywords (Figure 5-1). By default, BSAP assumes that all listed defects are condition state 4 (*severe*). Repair methods for *minor* and *moderate* damage are not included within BSAP, as they are not typically addressed during emergency situations. However, users can customize BSAP to include repair solutions for lower condition states, if desired. Additional condition states and customization for state-specific element numbers, defects, keywords, and repair options are outlined in the Developer's Guide to meet the needs to each user.

Figure 5-1. BSAP User Workflow

5.2 Opening BSAP

BSAP can be accessed through the main interactive PowerPoint format of BARRT (recommended) or through the **file directory**. To open BSAP from the BARRT PowerPoint, users simply click on the *BSAP* button which automatically opens the BSAP tool in Microsoft Excel (Figure 5-2).
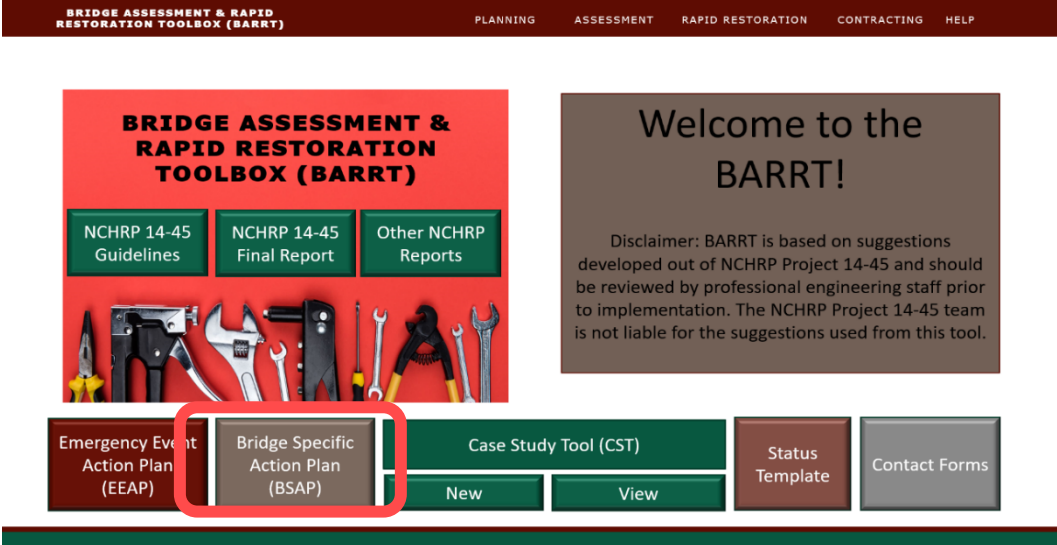
Figure 5-2. Accessing BSAP from BARRT

Alternatively, users can go directly to the **file directory** and click on the **BSAP** folder, which opens the files required to run BSAP. **BSAP.xlsm** opens the BSAP Excel Platform (Figure 5-3).
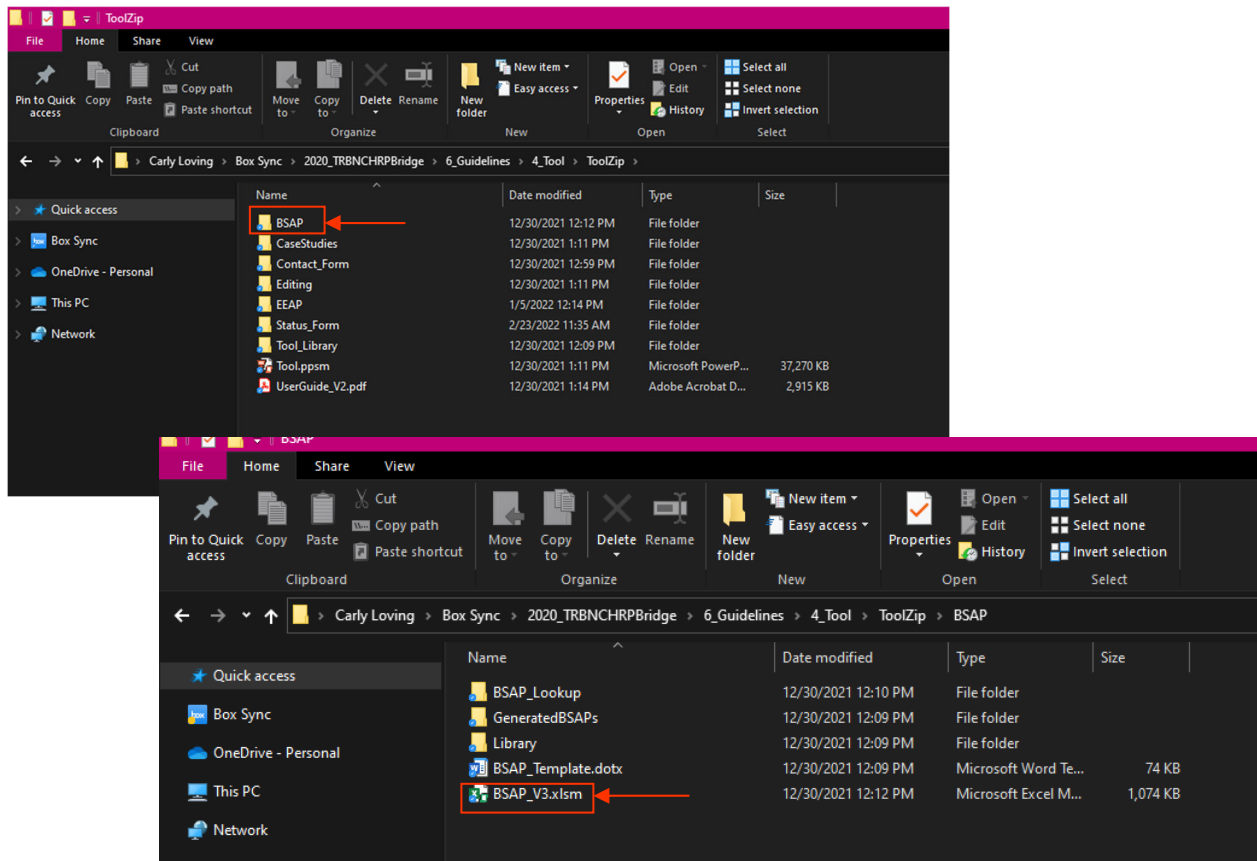
Figure 5-3. Opening BSAP from File Directory

5.3 How to Use BSAP

To run BSAP, users input a series of parameters to generate the suggested repair methods within Excel. Then, the preliminary recommendations are integrated into a Word document, which can be directly accessed through BSAP or BARRT. The databases that power BSAP are housed in the same Excel spreadsheet that run the program, but within separate hidden worksheets. These worksheets can be made visible for customization (see the *Developer's Guide* for more information).

From the BSAP tool home page (Figure 5-4), users input the required parameters, which are divided into three subsections: general information, location, and bridge repair. Users can input information for up to five elements for each BSAP generation. If additional elements are required, a new BSAP will need to be generated. The inputs are detailed in Table 5-1. The "keywords" parameter is defect specific (as shown in Table 5-1 by *) and is only displayed when the defect *7000 – Damage* is selected as the primary defect. It is important to note that keywords must be edited by users to access this function; keywords are not included by default (see the Developer Guide).

Figure 5-4. Main Input Page for BSAP Generation in Excel

Table 5-1. BSAP Input Parameters

Letter	Input	Action	Notes
		General Information	
A	Bridge Name	Type in the name of the bridge	Provide the name as it appears on State DOT inspection reports
B	Bridge Number	Type in the bridge number	As listed with the NBI
C	Inspection Date	Type in the date of when the inspection (DDA, EI, etc.) occurred	This is the inspection that provided the information inputted into BSAP
D	Corresponding Event	Type in the name of the emergency event that led to the damage	
E	Staff Member	Type in the name of the staff member filling out the form	
F	Staff Title	Type in the job title of the same staff member	
G	Organization	Type in the organization of the staff member	Examples include: Oregon DOT, City of Portland, Washington County
H	Department	Type in the department of the staff member	Examples include: Bridges and Structures, Maintenance, Planning
I	Phone	Type in the phone number of the staff member completing the form	Format: (###) ###-#### With extension: (###) ### - #### - extension
J	Email	Type in the email of the staff member completing the form	
		Location	
K	City	Type in the city the bridge is located	Provide the city as it appears on State DOT inspection reports.
L	State	Type in the state the bridge is located	Provide the state as it appears on State DOT inspection reports.
M	County	Type in the county the bridge is located	Provide the county as it appears on State DOT inspection reports
N	Region	Type in the State DOT's region the bridge is located	This could be numeric, names, or other labels depending on the State DOT. Put "N/A" if the State DOT does not have specific regions.
		Bridge Repair	
O	Bridge Type	Use the drop-down menu to select the correct type of bridge	For components such as bearings and joints, select them from the list
P	Element Number	Use the drop-down menu to select the primary damaged element of the bridge	If multiple elements are damaged, select the one that is most critical to the restoration of service
Q	Quantity	Enter the quantity of the element of interest in total. This includes damaged and undamaged.	The units will be either feet, squared feet, or each, depending on the bridge element. This will be automatically displayed based on the element number selected. Example: if a bridge has 6 columns, but only 2 are damaged, enter "6" in this box.

Letter	Input	Action	Notes
R	Defect Number	Use the drop-down menu to select the most applicable defect of the damaged element	If multiple defects are present, select the one that is the largest or most critical to the restoration of service
S	Percentage Damaged	Enter the percentage of damaged elements of interested.	Example: if a bridge has 6 columns, but only 2 are damaged, enter 33%.
T	Keywords*	Use the drop-down menu to select the most relevant keyword describing the damage, which are based on event type	This will only be displayed if the defect "7000 – Damage" is selected. Content will only be populated if previously edited by State DOTs.

Once all inputs are entered, users can generate a list of suggested repair methods by clicking on the *Generate BSAP* button (Figure 5-5).

Figure 5-5. Generating BSAP Output

A pop-up window will ask users to acknowledge that BSAP is computer generated and the output needs to be reviewed by a professional prior to implementation. To acknowledge this statement, users select *ok* (Figure 5-6). When BSAP is completed running, a pop-up will inform users. To acknowledge this pop-up, users select *ok* (Figure 5-7).
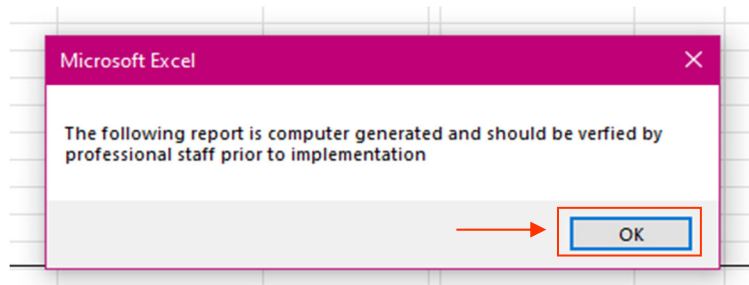
Figure 5-6. User Acknowledgement for BSAP
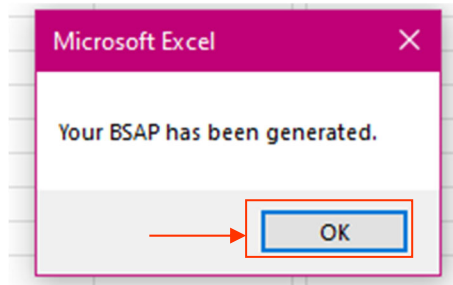
Figure 5-7. Pop-up for BSAP Generation Completion

To view the generated BSAP, users click on the *View Generated BSAP* button (Figure 5-8) to open the generated Word document. Depending on the device, Microsoft Word may automatically open on top of the opened BSAP Excel spreadsheet, or Microsoft Word may appear in the Windows taskbar and flash yellow (Figure 5-9). Users can click on the flashing Word logo to open the generated EEAP.

Figure 5-8. Viewing Generated BSAP

Figure 5-9. Flashing Yellow Word Generated Output

To generate a new BSAP, users can click on the *Clear Form* button, which empties the Excel spreadsheet (Figure 5-10). The user may now repeat the process to generate a new BSAP .

Figure 5-10. Creating a New BSAP Document

5.4 Understanding the BSAP Output

BSAP outputs a Word document (Figure 5-11) organized with four main headings: Summary, Suggested Repair Methods, Possible Temporary Solutions, and Signatures.

The list of suggested repair methods is provided in no order of significance or preference. The repair methods simply correspond to a list of possible options. The possible options should be fully vetted by engineering staff before drawing any final conclusions. Plans, specifications, and engineering drawings are not provided with the output. The design of the repair is left up to the transportation agencies.

Each section of the BSAP output is outlined in more detail in the following paragraphs.

5.4.1 Summary

The summary table provides a glimpse of the key inputs entered in BSAP, such as the bridge name and number, location, inspection information, and staff contacts. This can be used as a quick reference for reviewing the output after the fact and is also included in the **BSAP directory** (Section 5.5).

5.4.2 Suggested Repair Methods

The repair methods are based on findings from the AASHTO *Guide to Bridge Preservation Actions* and other literature are included in this section The project team presents applicable repair options based on the conclusions drawn in this report. Corresponding pages numbers are included so transportation agencies can easily reference the correct source for further details and recommended procedures. The reference column is organized by the reference number (Sx or BPG), which identifies the source of the repair method (Table 5-2). The reference number is followed by an underscore, which indicates the PDF page number in the source. Below the list of suggested repair methods, a blank space is provided for notes. Here, State DOTs can add specific details about the structure, transcribe a to-do list, or plan for the repairs.
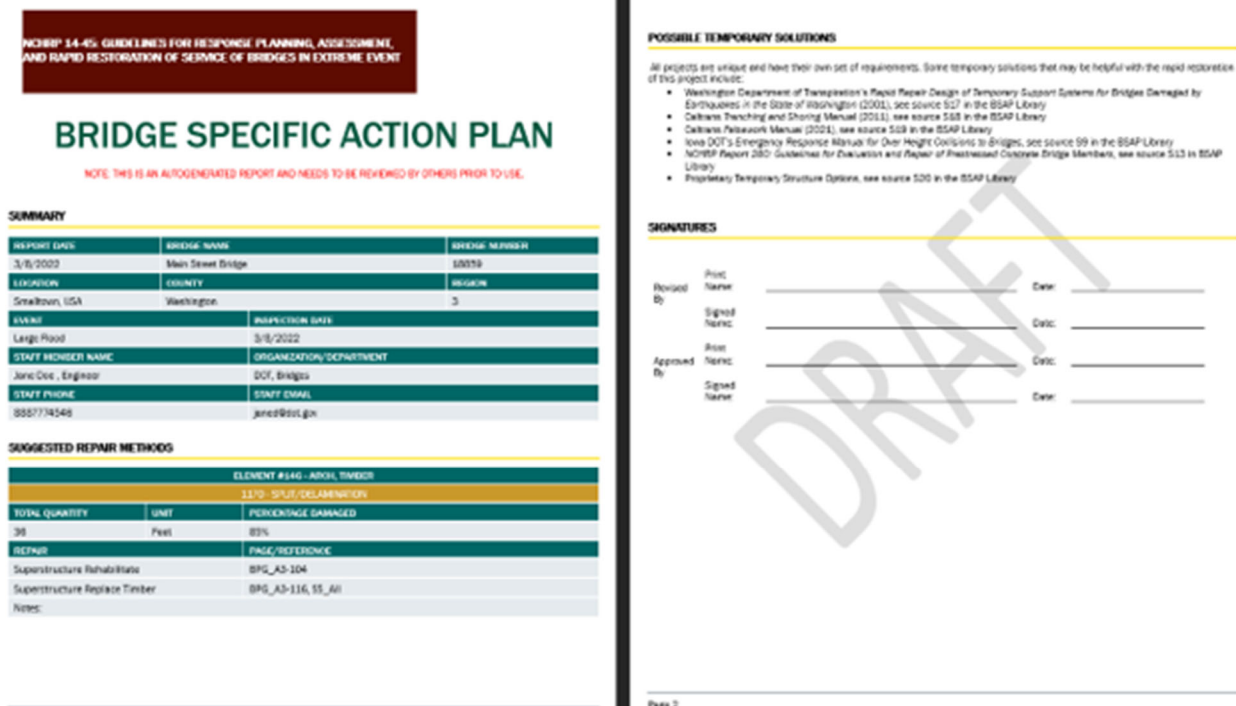
Figure 5-11. Sample BSAP Output

Table 5-2. Source Reference Numbers

Refence Number	Sources
BPG	AASHTO. 2021. Guide to Bridge Preservation Actions. AASHTO, Washington D.C.
S1	Ainge, S.W. 2012. Repair and Strengthening of Bridge Substructures. Marquette University, Milwaukee, WI.
S2	Arockiasamy, M. 1998. Evaluation of Conventional Repair Techniques for Concrete Bridges. Florida Atlantic University, Boca Raton, FL.
S3	Browne, T.M., T.J. Collins, M.J. Garlich, J.E. O'Leary, and K.C. Heringhaus. 2010b. Underwater Bridge Repair, Rehabilitation, and Countermeasures. FHWA, Washington D.C.
S4	Collins, T.J., R.J. Jarmakowicz, M.J. Garlich. 1989. Underwater Inspection of Bridges. FHWA, Washington D.C.
S5	Culmo, M.P. 2011. Accelerated Bridge Construction - Experience in Design, Fabrication and Erection of Prefabricated Bridge Elements and Systems. FHWA, McLean, VA.
S6	Davalos, J.F., A. Chen, I. Ray, A. Justice, M. Anderson. 2010. District 3-0 Investigation of Fiber Wrap Technology for Bridge Repair and Rehabilitation (Phase III). PennDOT, Washington D.C.
S7	Gangi, M., M. Jones, J. Liesen, J. Zhou, V. Pino, T.E. Cousins, C.L, Roberts-Wollmann, I. Koutromanos, and A. Nanni. 2018. Evaluation of Repair Techniques for Impact-Damaged Prestressed Beams. Virginia Department of Transportation, Richmond, VA.
S8	Harries, K.A., J. Kasan, and J. Aktas. 2009. Repair Method for Prestressed Girder Bridges. PennDOT, Harrisburg, PA.

Refence Number	Sources
S9	HDR. 2014. Emergency Response Manual for Over Height Collisions to Bridges. Office of Bridges and Structures Iowa Department of Transportation, Ames, IA.
S10	Japan International Cooperation Agency. 2017. Bridge Repair Manual. Japan International Cooperation Agency, Kojimachi, Japan.
S11	Lagasse, P.F., P.E. Clopper, J.E. Pagan-Ortiz, L.W. Zevenbergen, L.A. Arneson, D.D. Schall, and L.G. Girard. 2009. Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition Volume 2. NHI, Arlington, VA.
S12	G.O. Shanafelt and W.B. Horn. 1980. NCHRP Report 226: Damage Evaluation and Repair Methods for Prestressed Concrete Bridge Members. TRB, Washington D.C.
S13	G.O. Shanafelt and W.B. Horn. 1985. NCHRP Report 280: Guidelines for Evaluation and Repair of Prestressed Concrete Bridge Members. TRB, Washington D.C.
S14	Sinha, A., and M. Clauson. 2015. Evaluation of Pile Repair Splice Design. ODOT, Salem, OR.
S15	Sprinkel, M.M., A.R. Sellars, R.E. Weyers. 1993. Rapid Concrete Bridge Deck Protection, Repair and Rehabilitation. Strategic Highway Research Program, Washington D.C.
S16	Weyers, R.E., B.D. Prowell, M.M. Sprinkel, M. Vorster. 1993. Concrete Bridge Protection, Repair, and Rehabilitation Relative to Reinforcement Corrosion: A Methods Application Manual. Strategic Highway Research Program, Washington D.C.
S17	Washington State Department of Transportation (WSDOT). 2001. Rapid Repair Design of Temporary Support Systems for Bridges Damaged by Earthquakes in the State of Washington. WSDOT, Olympia, WA. Available: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.wsdot.wa.gov%2Fresearch%2Freports%2Ffullreports%2F542.2.pdf&clen=1121203&chunk=true [accessed 12 November 2021]
S18	Caltrans Offices of Structure Construction. 2011. State of California Department of Transportation Tenching and Shoring Manual. Caltrans, Sacramento, CA. Available: https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/structureconstruction/201906-sc-trenchingshoring-a11y.pdf [accessed 28 July 2021]
S19	Caltrans. 2021. Falsework Manual. Caltrans, Sacramento, CA. Available: https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/structureconstruction/sc-falsework-manual-a11y.pdf [accessed 3 June 2021]
S20	Newhouse, P. 2019. Emergency Bridging Strategy. Mainroads Western Australia, East Perth, Australia. Available: https://na.eventscloud.com/file_uploads/47781e7c6918d9df625cd15c442c90b8_Newhouse.pdf [accessed October 8, 2020]
S21	Avent, R.R. 2008. Guide for Heat Straightening of Damaged Steel Bridge Members. FHWA, Washington D.C.
S22	Kim, K.E., and B. Andrawes. 2016. Load Rating and FRP Retrofitting of Bridge Abutment Timber Piles. Illinois Center for Transportation, Springfield, IL. Available: //efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fapps.ict.illinois.edu%2Fprojects%2Fgetfile.asp%3Fid%3D4931 [accessed 22 December 2021]

5.4.3 Possible Temporary Solutions

For all generated BSAPs, a list of default temporary solutions is displayed. Users are encouraged to add or remove resources from this list in the **BSAP template** document to customize the results based on the State DOTs' needs, resources, and experience. Temporary solutions range from extensively damaged

systems such as temporary structures such as a Bailey Bridge, to more localized damage such as the *California Trenching and Shoring Manual* and *The California Falsework Manual.*

5.4.4 Signatures

When BSAP is generated, it should not be treated as a legal document; it merely shows suggested repair methods, and engineering staff is still required to read and fully vet the options provided. A reviewer and approver are highly encouraged to review and adapt the BSAP output. Once approved, the watermark *draft* can be removed and the document signed, signifying the output has been verified by qualified individuals.

5.5 Viewing Previous BSAPs from the BSAP Directory

Users can view previously generated BSAPs by opening the **BSAP directory** from the **file directory** (Figure 5-12).
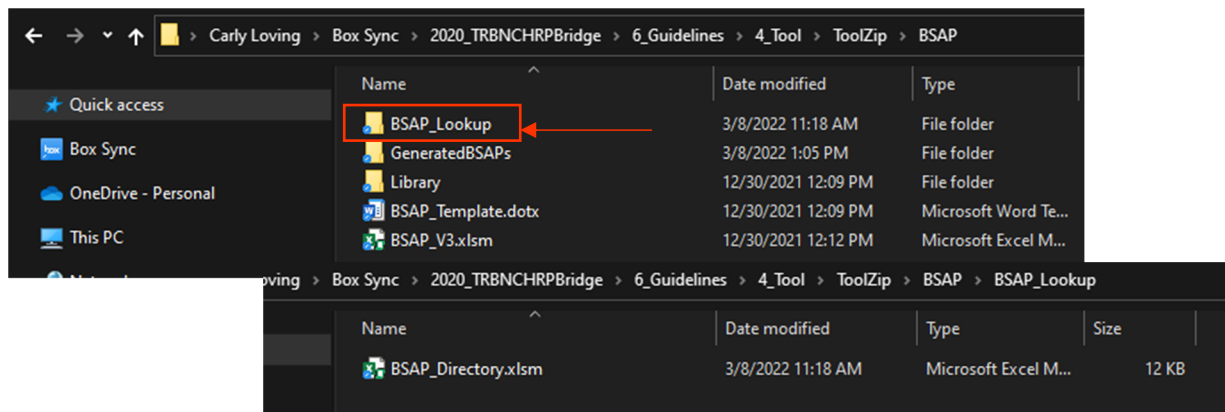
Figure 5-12. Opening BSAP Directory

The **directory** file contains an Excel workbook that lists all the previously generated BSAP documents. The workbook is automatically updated each time BSAP is run. From the **BSAP directory**, users can use the sorting features in Excel to filter the BSAP outputs based on their desired query. Queries can be organized by bridge name, corresponding event, bridge number, date, bridge type, etc. To filter the data,
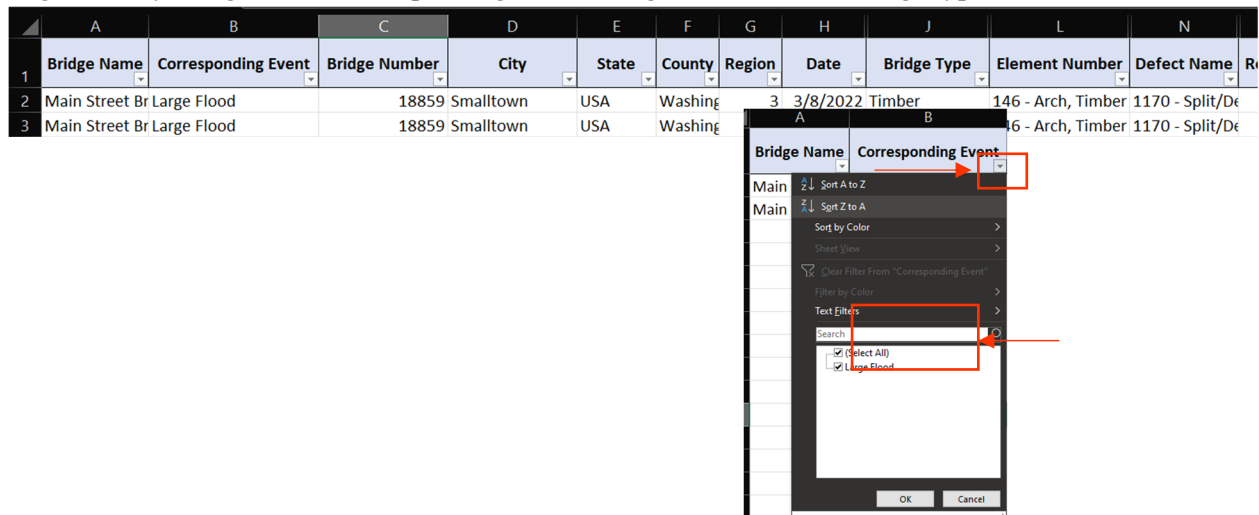
Figure 5-13. Sorting the BSAP Directory

users first click on the drop-down carrot on the desired query column. Then, users select the appropriate checkboxes to filter the entries (Figure 5-13). Once the desired BSAP file is found, users should keep track of the bridge name, as this is how the BSAP files are organized.

Users can then close the **directory** and open the generated BSAPs folder from the **file directory** by clicking on the **GeneratedBSAPs** folder and then selecting the name of the BSAP bridge from the listing of generated BSAPs (Figure 5-14).
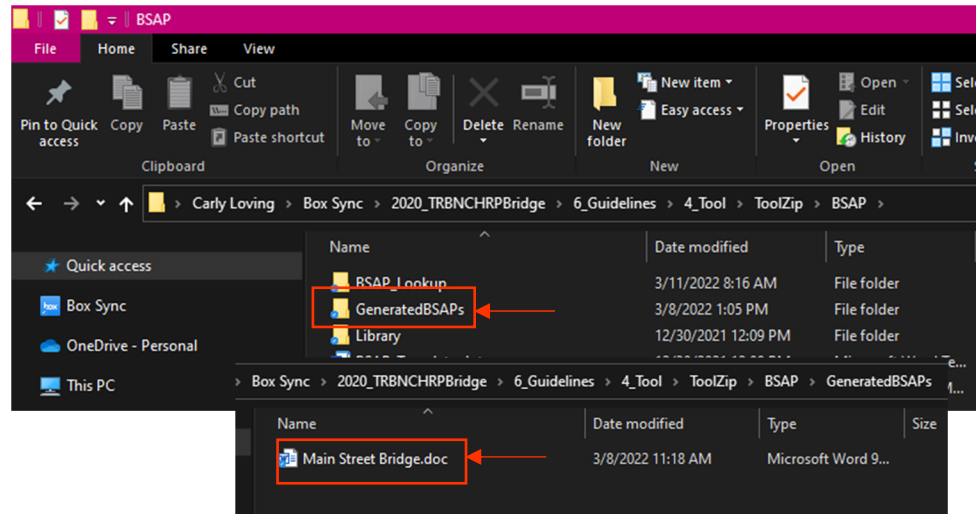
Figure 5-14. Opening Generated BSAPs from File Directory

5.6 BSAP User Example

An example is presented in this section to illustrate the use of the BSAP tool and generated outputs. For the example, an RC girder element 110 (Reinforced Concrete Girder/Beam) suffered severe rebar exposure after a semi-trailer truck collision. To determine the best repair option, the State DOTs decided to develop a BSAP and inputted the necessary information into BSAP (Figure 5-15).

Based on their inputs, the automated BSAP report would recommend 11 potential methods to repair the severely exposed rebar girder (Figure 5-16 and Figure 5-17). With this information, the State DOT then decided on the most appropriate option(s) to the specific case and edit the word file output. Along with the repair strategy, corresponding references are also listed. References such as "BPG_XXX" refer to the AASHTO's *Guide to Bridge Preservation Actions*, where users can go to the designated page number to find more information about implementing the repair.

Figure 5-15. BSAP Example Inputs

NCHRP 14-45: GUIDELINES FOR RESPONSE PLANNING, ASSESSMENT, AND RAPID RESTORATION OF SERVICE OF BRIDGES IN EXTREME EVENT

BRIDGE SPECIFIC ACTION PLAN

NOTE: THIS IS AN AUTOGENERATED REPORT AND NEEDS TO BE REVIEWED BY OTHERS PRIOR TO USE.

SUMMARY

REPORT DATE	BRIDGE NAME		BRIDGE NUMBER
12/26/2021	Main Street Bridge		1897A
LOCATION	**COUNTY**		**REGION**
Corvallis, OR	Benton		2
EVENT		**INSPECTION DATE**	
Semi Collision 2021		8/27/2021	
STAFF MEMBER NAME		**ORGANIZATION/DEPARTMENT**	
Jane Doe, Engineer		DOT, Bridges	
STAFF PHONE		**STAFF EMAIL**	
8888888888		JaneD@dot.gov	

SUGGESTED REPAIR METHODS

ELEMENT #110 - GIRDER/BEAM, REINFORCED CONCRETE	
1090 - EXPOSED REBAR	
TOTAL QUANTITY	**UNIT**	**PERCENTAGE DAMAGED**
150	Feet	65%

REPAIR	PAGE/REFERENCE
Superstructure Rehabilitate	BPG_A3-104
Reconstruct Beam End	BPG_A3-107
Stitch Shear Cracks	BPG_A3-107, S1_122
Superstructure Replace RC	BPG_A3-114, S5_All, S13_45
External Post-Tensioning	S2_26
Dry & Wet Mortar Spraying	S10_18, S10_34
Grouting	S10_18, S10_29

Figure 5-16. BSAP Example Generated Output (Page 1)

POSSIBLE TEMPORARY SOLUTIONS

All projects are unique and have their own set of requirements. Some temporary solutions that may be helpful with the rapid restoration of this project include:

- Washington Department of Transpiration's *Rapid Repair Design of Temporary Support Systems for Bridges Damaged by Earthquakes in the State of Washington (2001)*, see source S17 in the BSAP Library
- Caltrans *Trenching and Shoring Manual (2011)*, see source S18 in the BSAP Library
- Caltrans *Falsework Manual (2021)*, see source S19 in the BSAP Library
- Iowa DOT's *Emergency Response Manual for Over Height Collisions to Bridges*, see source S9 in the BSAP Library
- *NCHRP Report 280: Guidelines for Evaluation and Repair of Prestressed Concrete Bridge Members*, see source S13 in BSAP Library
- Proprietary Temporary Structure Options, see source S20 in the BSAP Library

SIGNATURES

Revised By Print Name: _____ Date: _____

Signed Name: _____ Date: _____

Approved By Print Name: _____ Date: _____

Signed Name: _____ Date: _____

Figure 5-17. BSAP Example Generated Output (page 2)

5.7 Editing BSAP Excel Workbook Content

5.7.1 Excel Worksheet Database Overview

Within BARRT, users input the main parameters for BSAP: general information, location, and bridge repair. With these inputs, BSAP uses search functions in Excel to scan the BSAP worksheet database. The Microsoft Excel worksheet database consists of worksheets hidden from view that are linked together. These worksheets contain the displayed options on the BSAP worksheet and update automatically based on user inputs. BSAP provides suggested repair methods based on bridge type, element number, and defect. Users may want to edit these to ensure that the suggested repair methods are consistent with methods used by their agency and reasonable based on local conditions.

To edit the content within BSAP, developers first open the BSAP workbook. By default, only the BSAP worksheet is visible. However, all worksheets within the BSAP workbook may need to be opened, depending on the specific editing needs. To open the additional worksheets within the BSAP workbook, developers right click on the BSAP worksheet at the bottom of the workbook and then select *unhide*. A popup window will appear, and developers can select the desired worksheets to unhide, then click *ok* when finished (Figure). To select multiple worksheets, press and hold the *ctrl* button on the keyboard while selecting the worksheets. The content of each worksheet is discussed in the following sections.
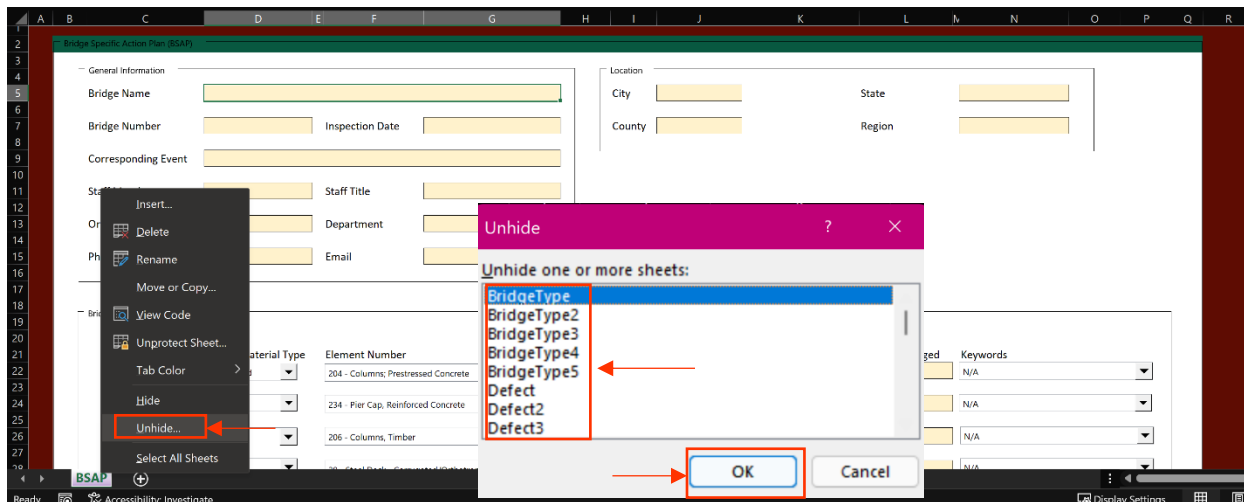

Figure 5-18. Opening a Hidden Worksheet in the BSAP Workbook

BSAP allows users to input data for up to five components. Thus, there are five copies of each worksheet, each corresponding to single component and organized in the same fashion. Each copy is denoted with a 2, 3, 4, and 5 after the worksheet name. For simplicity, this *Developer Guide* will only refer to one copy.

Across all worksheets, the green shaded cells are available for editing by developers. The orange shaded regions may still be edited, but would require adjustments to be made for the VBA code.

5.7.1.1 Bridge Type

The first worksheet helps determine the applicable bridge element based on the material of the bridge selected. The list of applicable elements updates based on the user selection for the bridge type, which are implemented as series of lookup functions based on the information in the Bridge Type worksheet.

5.7.1.2 Defect

Once users select both the bridge material and element of interest, the combo box displayed for the defect option on the BSAP worksheet is calculated in a similar fashion as the bridge element. The Defect worksheet consists of a series of array functions that display both the MBEI National Bridge Elements (NBEs) and Bridge Management Elements (BMEs) defects that are applicable for the selected element. This process ensures that only applicable elements are displayed based on the material type. The Defect worksheet does not contain any editable fields. Instead, this worksheet is made up of referenced cells from other worksheets that sort and compile the defects of the component. Similar to the Bridge Type worksheet, the columns are indexed to properly format the combo boxes on the BSAP worksheet.

5.7.1.3 Repair

The Repair worksheet contains the array functions that pull information from the Material Type and Material Elements worksheets. This worksheet organizes the referenced information and provides one location for the suggested repair options to be compiled, which is referenced to the Output worksheet to be displayed to the end user.

5.7.1.4 Keywords

The list of repairs provided by BSAP is not complete; some elements and/or defects do not have repairs listed to encourage State DOTs to add their own repair suggestions. Furthermore, if users selected the generic defect *7000 – Damage*, BSAP will not automatically generate repair suggestions. A stated by the MBEI, inspectors are advised to avoid selecting *Damage* as the defect, as it is not descriptive and does not provide the necessary information for selecting a repair method (AASHTO 2019). The *keywords* combo box becomes available to users when *7000 – Damage* is selected as the defect so that they can provide a clearer description of the damaged observed. These keywords are not included in BSAP by default, but can be added by developers (See Section 5.7.1.4). Thus, when using BSAP, users are encouraged to input one of the other defects besides *7000 – Damage* to yield a refined suggestion, or to customize the keywords if using *7000 – Damage* is desired.

5.7.1.5 Table

The Table worksheet is used to sort the suggested repair methods and format them for upload within the BSAP Word document template. It is strongly recommended that developers do not try to make edits to this worksheet without altering the VBA code.

5.7.1.6 Material Type

Each bridge type has its own Material Type worksheet that organizes the element names, defects, repairs, and keywords from the individual Material Elements worksheets.

5.7.1.7 Material Elements

The bulk of BSAP is run from the Material Elements worksheets. These are the sheets for developers to edit when customizing restoration methods, keywords, defects, and element numbers. The Material Elements worksheets are organized for each bridge element listed in the NBE and BME lists. These elements are organized by the parent category, which make up the Material Types worksheet. On each Material Element worksheet, all applicable defects and corresponding suggested repair methods (which may be further subdivided by keywords for damaged elements) are listed in the worksheet. These worksheets are those that will be primarily edited for customization, as the other worksheets generally reference the information found in these worksheets and organize them in an easier to dissect format.

5.7.1.8 Output

Overview
The Output worksheet captures the type-in data (location and staff information) collected on the BSAP worksheet. It also stores the selections made with the various combo boxes on the BSAP worksheet, and the suggested repair methods. This worksheet is used by the code to generate the output Word document.

Output Generation

The Word document output is generated using a pre-developed template (Figure 5-19 to Figure 5-21), which includes placeholders that are exchanged for the generated content using a series of find and replace commands executed by the embedded VBA code. In the corresponding section of the template, the specific placeholder is searched and replaced with the text in the Output worksheet in Excel. The code runs through all the placeholders in the document, then saves the file as a Word document in the **Generated BSAP subfolder**. During this process, the information on the Output worksheet in Excel is also copied to the BSAP directory so users can search for previously generated BSAPs. The BSAP directory can be accessed directly from the **BARRT file directory**. To view the desired BSAP, users can use the event type and name to navigate through the **file directory** to find the specific report of interest.

5.7.2 Editing the Excel Worksheet Databases

Not all of the worksheets are designed to be edited. It is strongly recommended that a developer avoid editing the following worksheets:
- Defect
- Repair
- Keywords
- Output
- Table

If these worksheets are edited, significant changes to the VBA code will be required, as these worksheets call data from other worksheets (like the Material Type worksheets) and sort the data for display on the BSAP worksheet or the BSAP output Word document. The worksheets that can be edited include:
- Bridge Type
- Material Type
- Element Type

The bulk of edits for BSAP are made within the Element Type worksheet including defects, keywords, and repairs.

NCHRP 14-45: GUIDELINES FOR RESPONSE PLANNING, ASSESSMENT, AND RAPID RESTORATION OF SERVICE OF BRIDGES IN EXTREME EVENT

BRIDGE SPECIFIC ACTION PLAN

NOTE: THIS IS AN AUTOGENERATED REPORT AND NEEDS TO BE REVIEWED BY OTHERS PRIOR TO USE.

SUMMARY

REPORT DATE	BRIDGE NAME		BRIDGE NUMBER
#Today	#BridgeName		#Number
LOCATION	COUNTY		REGION
#City, #State	#County		#Region
EVENT		INSPECTION DATE	
#Event		#Date	
STAFF MEMBER NAME		ORGANIZATION/DEPARTMENT	
#Staff, #Title		#Organization, #Department	
STAFF PHONE		STAFF EMAIL	
#Phone		#Email	

SUGGESTED REPAIR METHODS

ELEMENT ##ELE1		
#DEFECT1		
TOTAL QUANTITY	UNIT	PERCENTAGE DAMAGED
#Quantity1	#Unit1	#Percent1%
REPAIR		PAGE/REFERENCE
#Element1		
Notes:		

ELEMENT ##ELE2		
#DEFECT2		
TOTAL QUANTITY	UNIT	PERCENTAGE DAMAGED
#Quantity2	#Unit2	#Percent2%
REPAIR		PAGE/REFERENCE
#Element2		

Figure 5-19. BSAP Template – Page 1

Figure 5-19. BSAP Template – Page 1

Notes:

ELEMENT ##ELE3		
#DEFECT3		
TOTAL QUANTITY	UNIT	PERCENTAGE DAMAGED
#Quantity3	#Unit3	#Percent3%
REPAIR		PAGE/REFERENCE
#Element3		
Notes:		

ELEMENT ##ELE4		
#DEFECT4		
TOTAL QUANTITY	UNIT	PERCENTAGE DAMAGED
#Quantity4	#Unit4	#Percent4%
REPAIR		PAGE/REFERENCE
#Element4		
Notes:		

ELEMENT ##ELE5		
#DEFECT5		
TOTAL QUANTITY	UNIT	PERCENTAGE DAMAGED
#Quantity5	#Unit5	#Percent5%
REPAIR		PAGE/REFERENCE
#Element5		
Notes:		

POSSIBLE TEMPORARY SOLUTIONS

All projects are unique and have their own set of requirements. Some temporary solutions that may be helpful with the rapid restoration of this project include:

- Washington Department of Transpiration's *Rapid Repair Design of Temporary Support Systems for Bridges Damaged by Earthquakes in the State of Washington* (2001), see source S17 in the BSAP Library
- Caltrans *Trenching and Shoring Manual* (2011), see source S18 in the BSAP Library
- Caltrans *Falsework Manual* (2021), see source S19 in the BSAP Library
- Iowa DOT's *Emergency Response Manual for Over Height Collisions to Bridges*, see source S9 in the BSAP Library
- *NCHRP Report 280: Guidelines for Evaluation and Repair of Prestressed Concrete Bridge Members*, see source S13 in BSAP Library
- Proprietary Temporary Structure Options, see source S20 in the BSAP Library

SIGNATURES

Figure 5-20. BSAP Template – Page 2

Revised By	Print Name:		Date:	
	Signed Name:		Date:	
Approved By	Print Name:		Date:	
	Signed Name:		Date:	

Figure 5-21. BSAP Template – Page 3

5.7.1.1 Bridge Type Editing

The green cells in column B on the Bridge Type worksheet can be edited to rename the different bridge types. Column A contains the numbers 1 to 9. It is strongly recommended to not alter these values, as they are part of the code that fills the combo boxes on the BSAP worksheet (Figure 5-22).

Figure 5-22. Updating the Bridge Type Names from the Bridge Type Worksheet

The Bridge Type worksheet also contains a series of elements that are specific to each bridge type, which are shaded orange (Figure 5-23). These lists are referenced to cells from other worksheets, so it is important developers do not edit these. The orange shaded cells display the elements name and number for each bridge type on the BSAP worksheet (Figure 5-24). The orange shaded cells appear to be repeated across two different sets of columns (Columns C to L and Columns N to W). The second set (Columns N to W) are referencing the Material Type worksheet, and the first set (Columns C to L) are indexing from the second set to be formatting properly for the combo boxes on the BSAP worksheet.

Figure 5-23. Cells that Reference other Worksheets should not be Edited

Figure 5-24. Element Numbers and Name from BSAP Worksheet are Derived from the Bridge Type Worksheet

5.7.1.2 Material Type Editing

The Material Type worksheet can be edited by developers to change the element name and numbers listed for each bridge type. The Material Type worksheet consists of nine worksheets: Concrete, Prestressed, Steel, Timber, Masonry, Other, Bearing, Joint, and None. These worksheets all have a similar layout, with the element name and numbers in columns B to C, followed by the corresponding element names and their defects, keywords, and page numbers (starting in Column E). To edit the element names and numbers, developers can type in the green regions of Columns B and C (Figure 5-25a). If the names of elements are changed, the corresponding Material Element worksheet should be renamed to match the name listed in the Material Type worksheet for consistency. The worksheet tabs can be renamed by right clicking on the desired tab and clicking *rename.* The units for each element (which are described by the BME or NBE) can be edited in Column Y (Figure 5-25b).

(a)   (b)

Figure 5-25. Editing Element (a) Names and Numbers and (b) Units in Material Type Worksheets

Figure 5-26. Editing Element Name and Number Plus Adjusting the Corresponding Material Element Worksheet Name

If additional elements need to be added beyond the blue region, then the VBA code will need to be updated. Additional Material Element worksheets will also need to be added. It is strongly recommended that Column A remain unedited, as this helps with indexing the element names in the combo boxes on the BSAP worksheet.

5.7.1.3 Material Elements Editing

The bulk of the edits are completed on the Material Elements worksheets, particularly for defects, keywords, and repair suggestions. There are hundreds of worksheets that make up the Material Elements worksheets with one worksheet for each element listed within BSAP. A typical Material Element worksheet is shown in Figure 5-27. The Material Elements worksheets are based off defect type (Columns B and C in Figure 5-27). The repairs and page numbers listed in Column E and Column D correspond to the defect listed in the same row. Thus, multiple repairs and page numbers are included in the cells of Columns E and D, respectively. However, for the keywords (darker green region of Figure 5-27), the repairs do not coordinate with the defects in Columns B and C, as the keywords assume that a defect of *7000 – Damage* has been selected. The page numbers and repairs in Columns G and H correspond to the listed keywords in Column E, but not the defects in Columns B and C. The following sections detail how to edit each of these components.

Defects

To edit the defects, developers can type in the green shaded regions of Columns (Figure 5-27). The defect name should be listed in Column B and the corresponding defect number in Column A. It is strongly recommended that developers do not edit Column A, as this provides an index to other worksheets such as the Material Type, Defects, and Repairs. Nevertheless, if a developer wishes to add additional defects in the orange regions, the VBA code will need to be adjusted.

Figure 5-27. Where to Make Edits in the Material Element Worksheet

Repairs

To edit the repairs, developers can edit the red regions in Column E for the repair and Column D for the corresponding page number and source. When editing the repairs in Column E, developers need to keep the format of *name of repair; name of repair;* where semicolons separate different repair suggestions for each corresponding defect. The order of the repairs is important, as the corresponding source page numbers are listed in the same order (i.e., the third listing of Column D is the source page number for the third repair listed in Column E). The page numbers are coded by a letter/number, and the source documents are saved in the **BSAP Library**, as described in Chapter 5 of the User Manual. To add additional sources to **BSAP Library**, developers should first create a PDF of the document. Developers should continue with the naming convention and add the next number in the source count (developers can look in the current **BSAP Library** to determine the next number in the list): *Sxx_pagenumber*, where *xx* is the next number in the list from the **BSAP Library**. Developers then should save the named PDF within the **BSAP Library** (Figure 5-28).
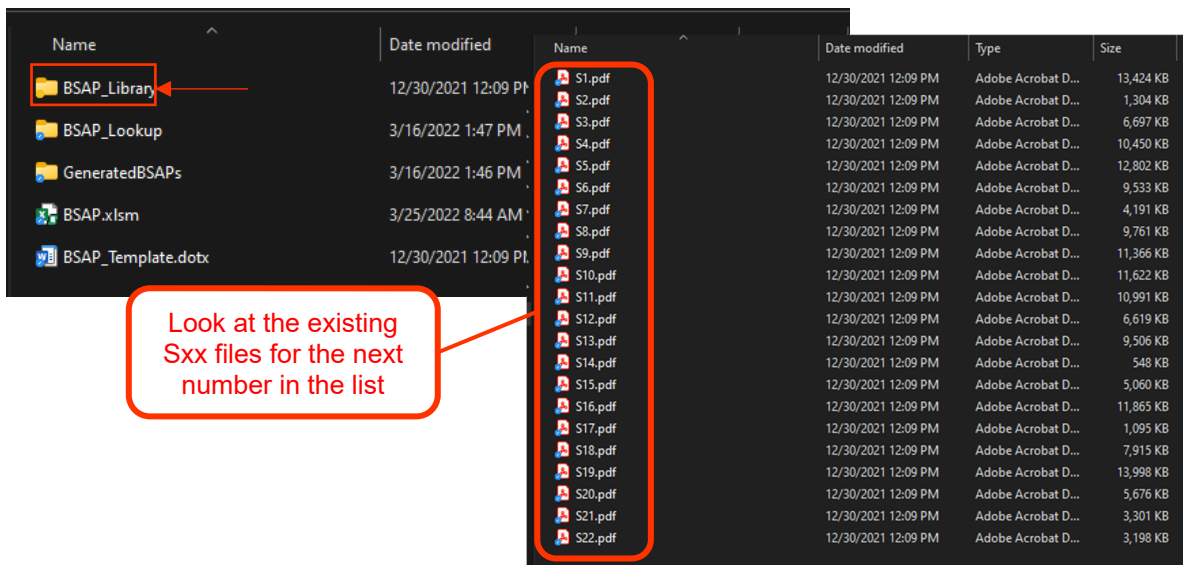
Figure 5-28. Saving New Sources to the BSAP Library

Keywords

The keywords are not included in BSAP by default, so it is completely up to State DOTs to use this feature within BSAP. Developers first need to add the desired keywords. Developers can fill up the entire blue region of Column F without needing to update the VBA code (Figure 5-27). The intent of the keywords is to refine repair solutions for elements that are marked as "damaged"; hence, State DOTs can use whichever keywords they feel are most beneficial to their inventory. Then, the suggested repair methods and their corresponding sources with page numbers should be added in a similar fashion to Columns D and E (Figure 5-27).

It is important to note that only elements that are indicated as *7000 – Damage* as their defect on the BSAP worksheet will have options listed in the keywords combo box (Figure 5-29). Other defects do not have any keywords listed by default. BSAP lists *other* as the only keyword, but not any additional keywords, and there are not specific repairs assigned to *other*.
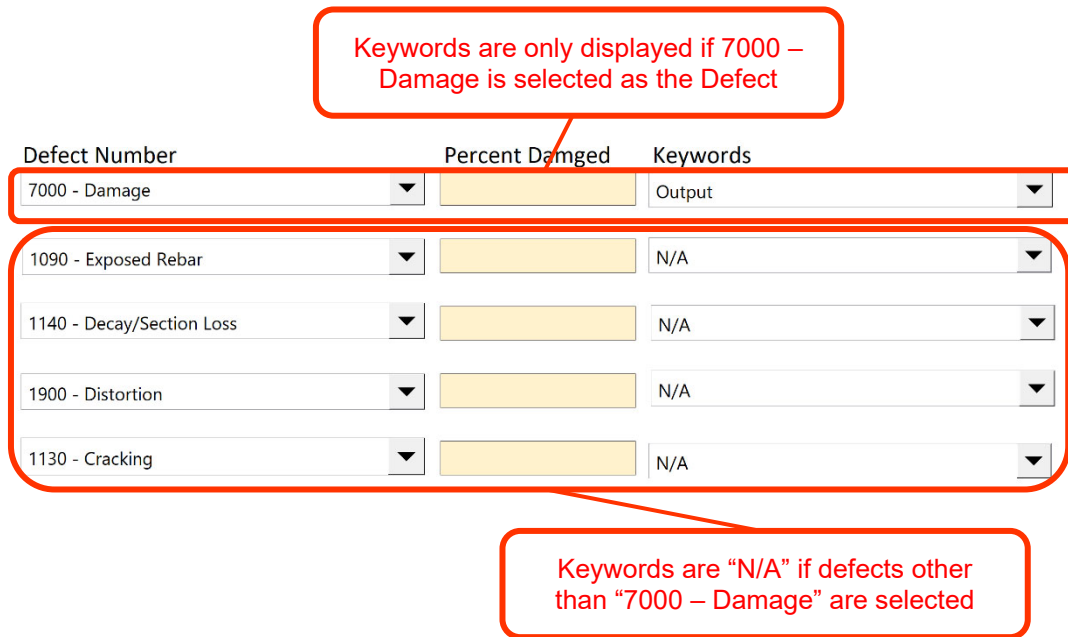
Figure 5-29. Keywords are Dependent on the Defect Input from the BSAP Worksheet

5.8 Editing BSAP Word Document Template

The Word template (Figure 5-19 to Figure 5-21) used by BSAP to generate the Word document output can be edited. To edit the template, developers can open the Word template from the **BSAP file directory** by clicking on **BSAP_Template.dotx** (Figure 5-30).
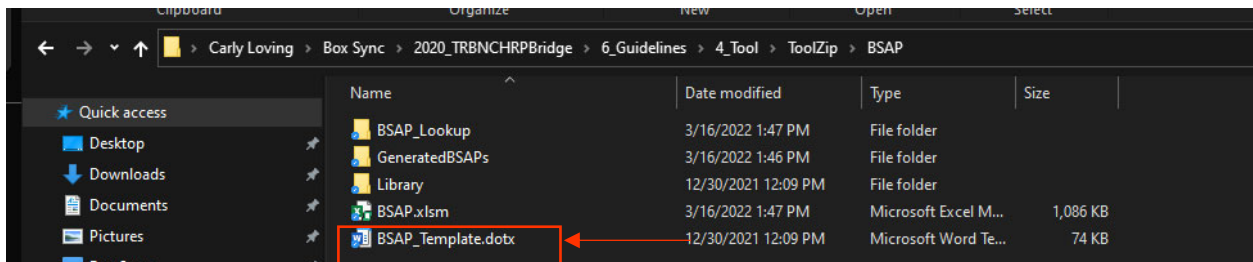
Figure 5-30. Opening BSAP Word Template from BSAP File Directory

When the template opens, developers can edit any of the text that does not have a "#" in front of it. The "#" symbol is used by the VBA code to copy the data from the Output worksheet of the BSAP workbook and paste it into the Word document. The formatting of the table and the headings can be altered as long as the "#" text remains the same, the VBA code will not need to be adjusted.

Once the desired formatting and text is updated in the template, developers will need to save the template as a new template (this process is identical to saving the EEAP template) by going to the *file* tab and clicking *save as* (Figure 5-31). Then developers click *browse* and navigate to the **BSAP file directory**.
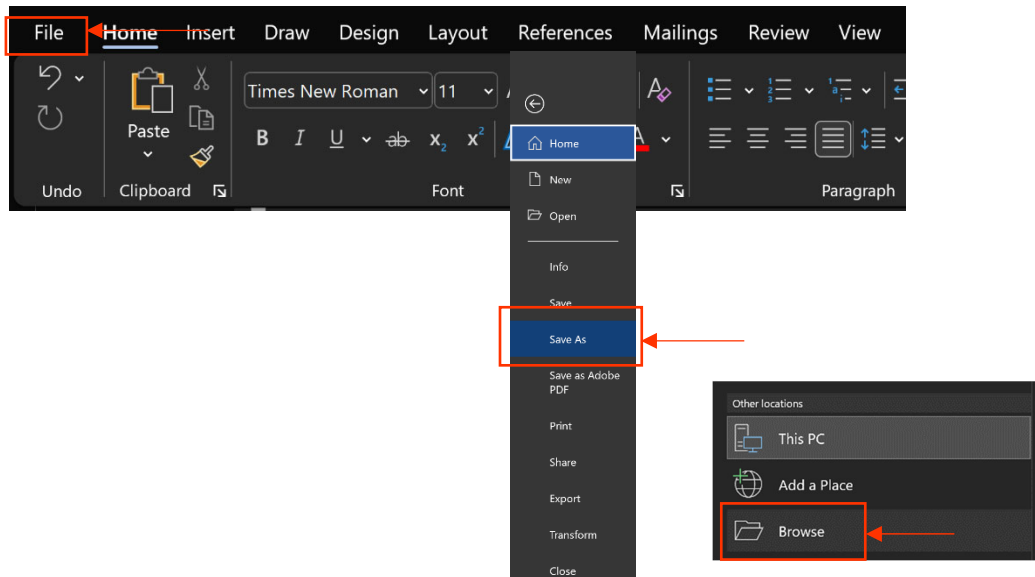
Figure 5-31. Saving the Updated Word Template via "Save As"

Then, the name of the template needs to be entered: **BSAP_Template1.dotx**. The file name cannot be **BSAP_Template.dotx** as that is the name of the original template, and Microsoft Word is unable to overwrite this existing file in this case. The file type also needs to be changed to a *Word Template* (***.dotx***) from the drop-down menu under *save as type* (Figure 5-32). The document can be saved by clicking *save* (Figure 5-33).
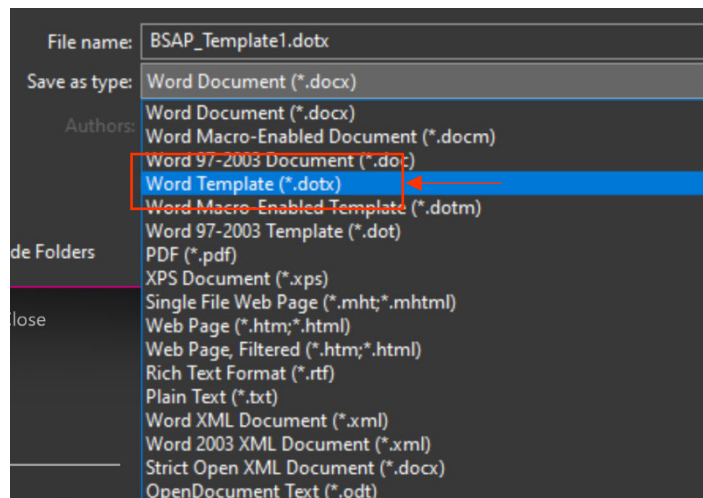
Figure 5-32. Changing the File Type to a Word Template
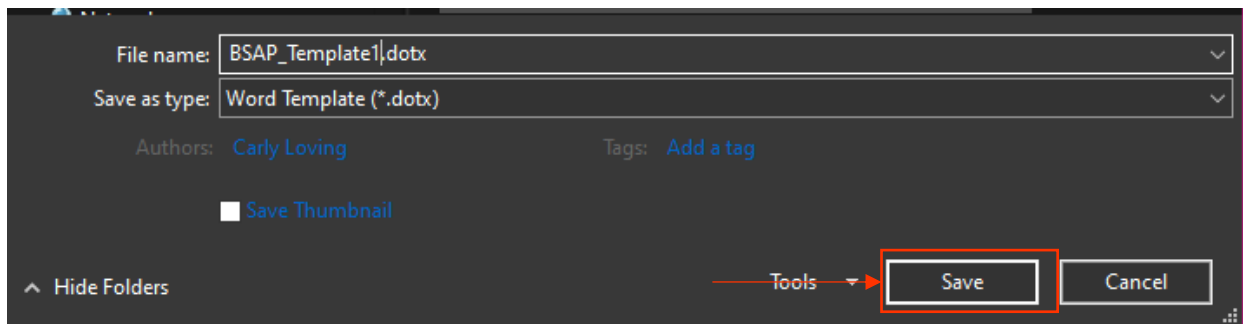
Figure 5-33. Saving the Edited BSAP Template File as "BSAP_Template1.dotx"

From the BSAP file directory, the original BSAP_Template.dotx file can be deleted, and the newly created BSAP_Template1.dotx file must be renamed to BSAP_Template.dotx as this is the name that the VBA code expects. To rename the template, developers right click on the file, select rename, and remove the "1" in the file name.

Chapter 6: Case Study Tool (CST)

6.1 Overview

The Case Study Tool (CST) is another primary tool within BARRT. This tool provides a sample of real-life projects that can serve as examples for State DOT-specific knowledge transfers and to share lessons learned with other State DOTs. The CST has two features: (1) to generate new case studies from an Excel and Word-based template, and (2) to review existing case studies (Figure 6-1). The CST is preloaded with 27 case studies and include a form to quickly generate additional case studies in the same format. The existing case studies are PDFs of Word documents and the template case studies are Word documents that contains a brief overview of the emergency event, cost, assessment techniques, type of repairs, and key lessons learned with each project. The included case studies are based on the NCHRP 14-45 literature review and were collected from several state transportation agencies from across the United States. They represent a wide breadth of emergency event types, assessment techniques, and repair solutions adopted in real projects. As with other tools, the CST can be customized following the procedures outlined in the Developer Guide.
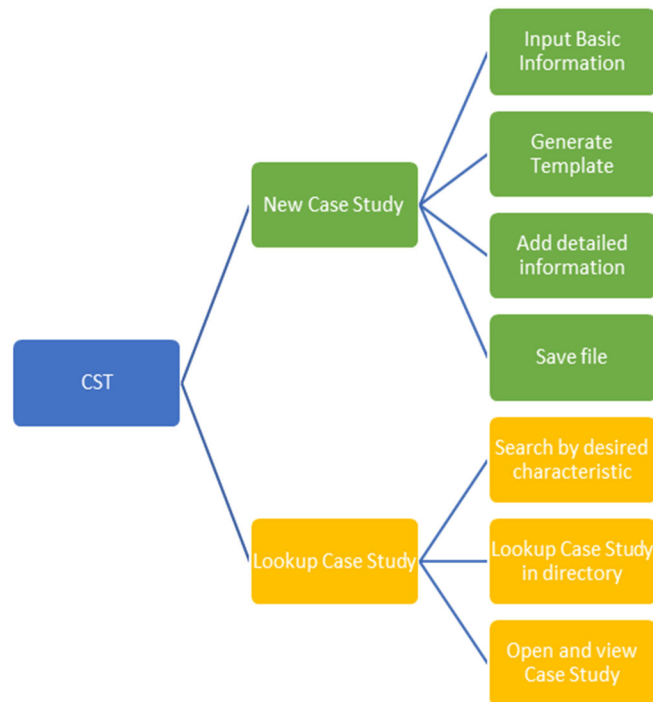
Figure 6-1. CST User Workflow

6.2 Opening CST

CST can be accessed through the main interactive PowerPoint format of BARRT (recommended) or through the **file directory**. To open CST from the BARRT PowerPoint, users simply click on the CST button which automatically opens the CST tool in Microsoft Excel (Figure 6-2).
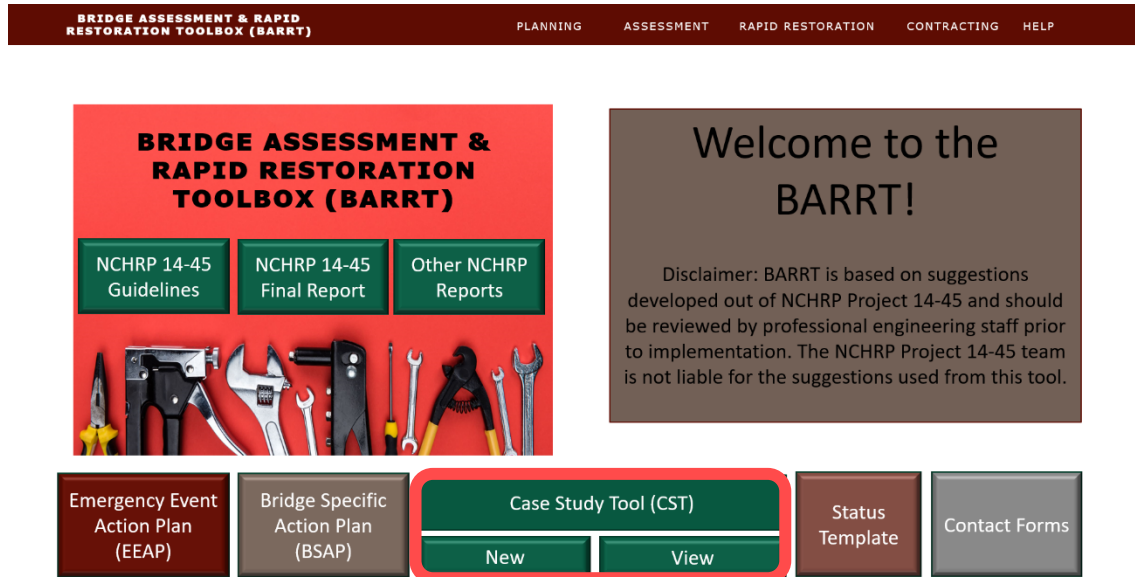
Figure 6-2. CST from BARRT

Alternatively, users can go to the **file directory** to open CST. To generate a new case study, users click on the **CaseStudies.xlsm** Excel workbook. To open an existing case study, users can click on *CaseStudies_Lookup* folder to search for a case study or click on *Generated_CaseStudies* to open a specific case study (Figure 6-3).
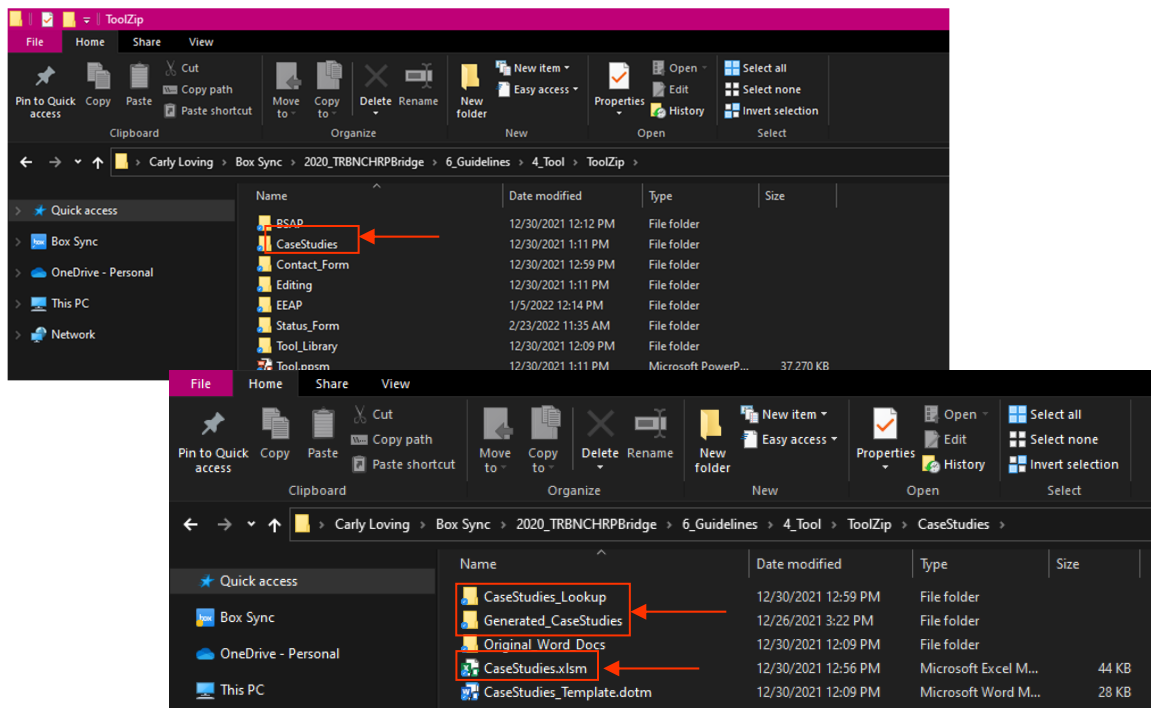
Figure 6-3. Opening CST from File Directory

When users select *New* from the BARRT home page, Excel opens, and users may be prompted to update external sources (Figure 6-5). Users can select *Update*, followed by *Continue* if updates are not available (Figure 6-4).
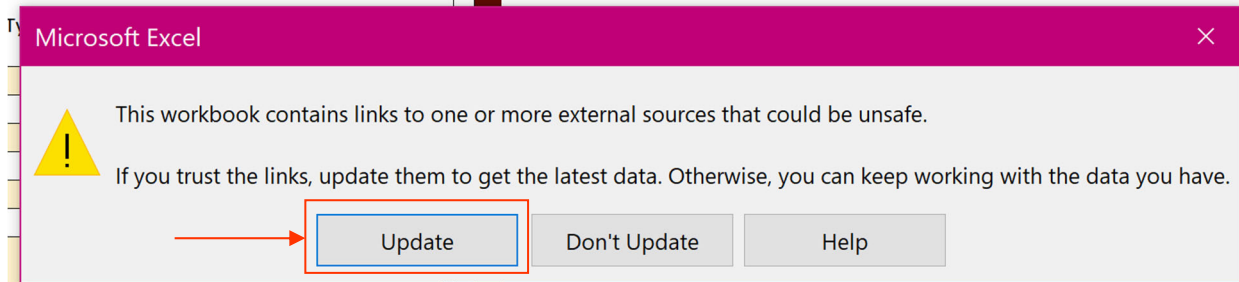
Figure 6-5. CST Update External Sources
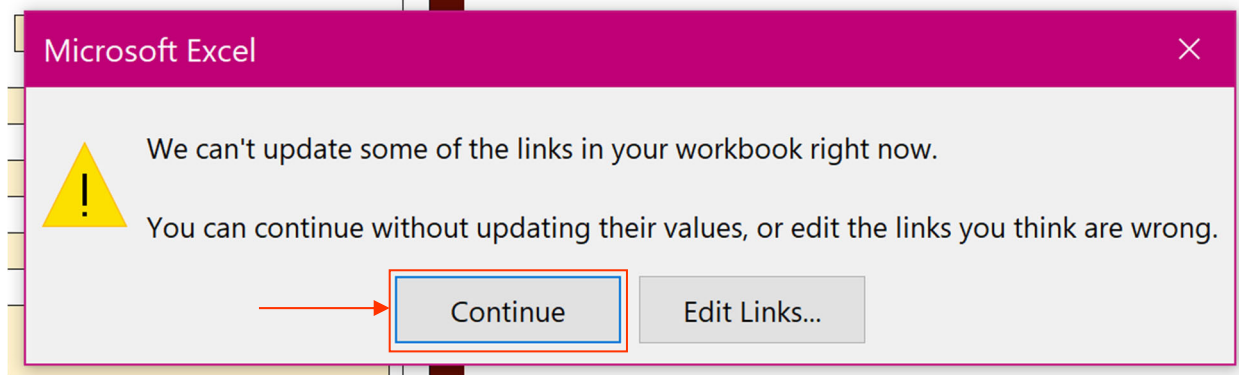
Figure 6-4. CST Update External Sources Part 2

6.3 How to use CST

6.3.1 Creating a New Case Study

Users can use the CST to create a template for a new case study. This template matches the format of the preloaded case studies that are included in the tool by default, and includes the at-a-glance table for key case study information, and headings to format the written description of the case study. The template is first created in Excel which is used to generate the Word document for the case study.

To generate a new case study, users input the main parameters into CST on the CST home page (Figure 6-6 and Table 6-1): name, number, event type, year, scope, cost, planning, assessment, and rapid restoration methods, and innovations. Users are also prompted to enter contact information for personnel who can be contacted for further information for that specific case study.

Figure 6-6. CST Excel Home Page

Table 6-1. CST Input Parameters

Letter	Input	Action	Notes
		General Information	
A	Case Study Name	Type in the name of the Case Study	Provide the name that the event/bridge is commonly referred to. Could be based on news media names, Inspection Reports, or the "common name"
B	Event Type	Select from the drop-down the type of emergency event	"Other" captures all other types of events that are not listed in the drop down. This could include, but is not limited to, immediate actions taken due to routine inspections, other natural hazards not listed, ABC projects that were scheduled due to routine deterioration and not an emergency event, etc.
C	Year	Type in the year the event occurred	
D	Bridge Type	Type in the type of bridge	Examples include reinforced concrete, steel, wood, masonry
E	Bridge Name	Type in the name of the bridge	Provide the name as it appears on the bridge inspection report
F	Scope	Type in the scope of the emergency event	Examples include: 2 spans damaged, 4 girders replaced, total bridge closure
G	Cost	Type in the approximate cost of the emergency event as it pertains to this bridge	Include assessment and repair (including temporary repairs) costs. Do not include emergency event response
H	Planning Techniques/ Tools	Type in the planning methods used for the project	For some events, there may not be planning techniques used, so the user can put N/A. Planning implies preparation before the event occurred
I	Event Response	Type in the event response activities and methods used because of the event	Examples includes detours, closures, improvements to detour routes, etc.
J	Assessment Techniques/ Tools	Type in the assessment techniques or tools that were used to assess the structure	Examples include visual inspection, lidar, ground penetrating radar, etc.
K	Rapid Restoration Type	Type in the rapid repair methods used to re-establish service of the bridge	Examples include ABC, prefabricated components, temporary systems, or shoring.
L	Innovations	Type in the main lessons learned from this project	These will appear as a bulleted list in the Word template, so complete sentences are not needed. One bullet will be generated per innovation
		Contact Information	
M	Staff Name	Type in the name of the staff member who should be contacted for additional information	This person may not be the same person that is filling out the form, but should give approval for their knowledge on the project
N	Position	Type in the job title of the same staff member	

Letter	Input	Action	Notes
O	Organization	Type in the organization of the staff member	Examples include: Oregon DOT, City of Portland, Washington County
P	Department	Type in the department of the staff member	Examples include: Bridges and Structures, Maintenance, Planning
Q	Phone	Type in the phone number of the staff member completing the form	Format: (###) ###-#### With extension: (###) ### - #### - extension
R	Email	Type in the email of the staff member completing the form	

To generate the CST template, users click on the *Generated Case Study* button (Figure 6-7).
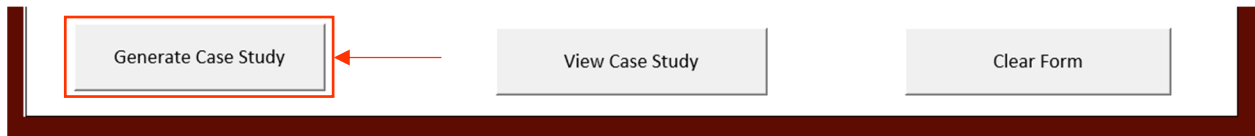
Figure 6-7. Generating a New Case Study Template

A pop-up window will ask users to acknowledge that CST is computer generated and the output needs to be reviewed by a professional prior to implementation. To acknowledge this statement, users select *ok* (Figure 6-8). When CST is completed running, a pop-up will inform users. To acknowledge this pop-up, users select *ok* (Figure 6-8).
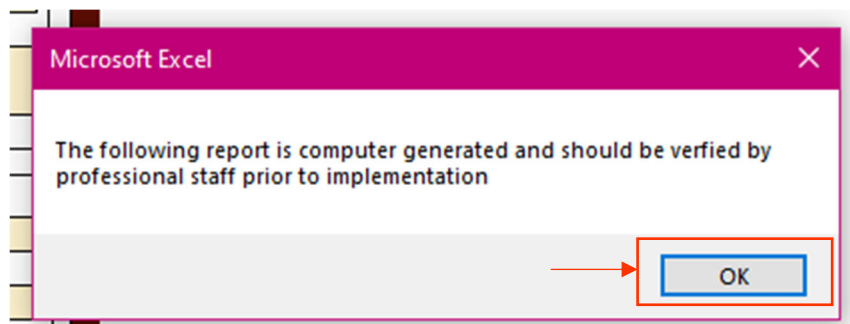
Figure 6-8. User Acknowledgement for CST

To view the generated case study, users click on the *View Case Study* button (Figure 6-9), which opens up the generated Word document. Depending on the device, Microsoft Word may automatically open on top of the opened CST Excel spreadsheet, or Microsoft Word may appear in the Windows taskbar and flash yellow (Figure 5-9). Users click on the flashing Word icon to open the generated case study .
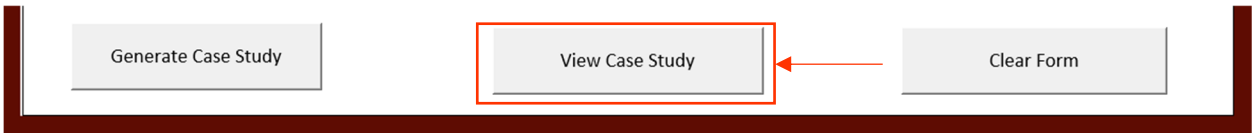
Figure 6-9. Viewing Generated Case Study Template

Figure 6-10. Flashing Yellow Word Generated Output

To create a new CST, the Excel workbook can be cleared using the *Clear Form* button (Figure 6-11).
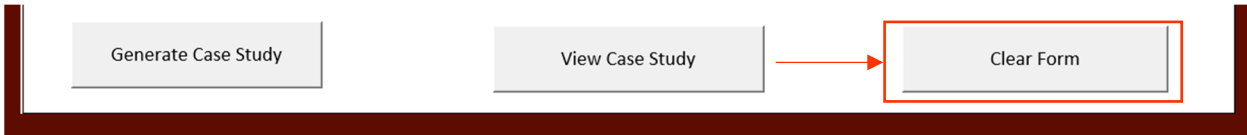
Figure 6-11. Creating a New Case Study Template

6.3.2 Viewing an Existing Case Study

6.3.2.1 Looking up a Case Study from the CST Directory.

The CST Directory is an Excel workbook and is used to lookup an existing case study based on a variety of identifying information, such as event type, repairs used, and cost. The workbook is automatically updated each time a new case study is generated with the Case Study template. It also is preloaded with the default case studies included with CST. The CST Directory content is generated with the tabular information in the beginning of each Case Study, which originates from the Excel CST home page inputs. The CST Directory can be accessed from the BARRT PowerPoint by clicking on *View* (Figure 6-3), or from the **file directory**. From the **file directory**, users click on the *CaseStudies_Lookup* file, and then **CaseStudies_Directory.xlsm** to open the CST Directory (Figure 6-12).
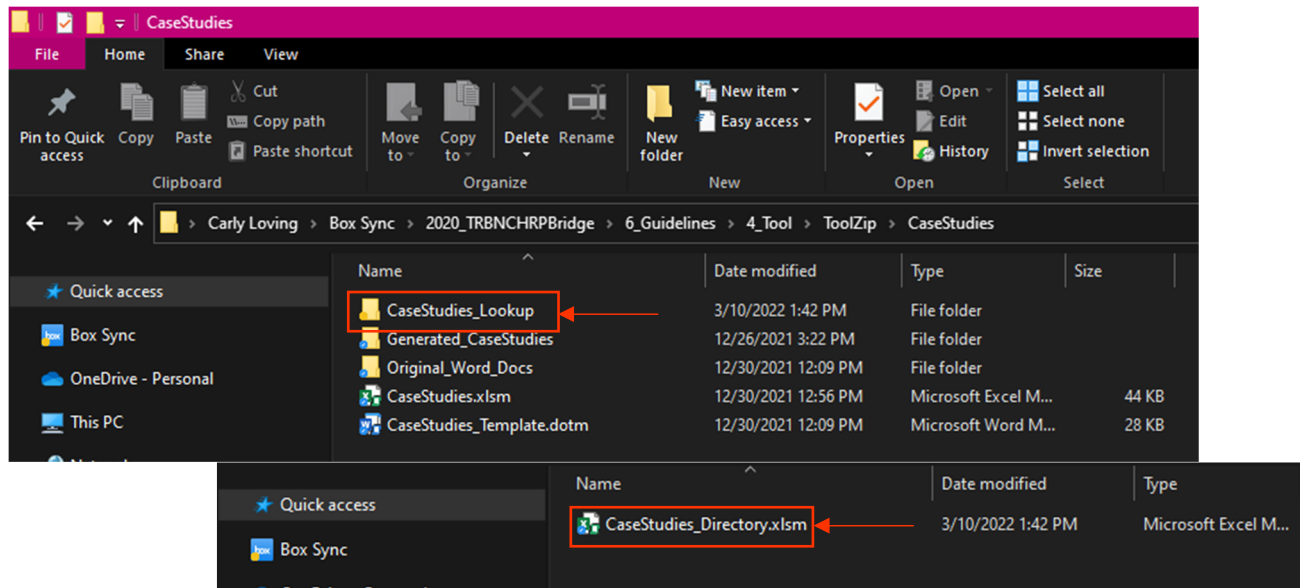
Figure 6-12. Opening CST Directory from the File Directory

Once the CST Directory opens (Figure 6-13), users can use the built-in filters in Excel to select desired characteristics of the listed Case Studies to help navigate to the document they would like to view.

Figure 6-13. CST Directory

To open the built-in filters in Excel, users first click on the drop-down carrot on the column they want to filter by (Figure 6-14). Then, using the checkboxes, users select the entries they want to filter by. This sorts the data by the specified figures. Once a desired case study is found, users should make note of the event type and case study name. These two identifiers are used to search for a specific case study.
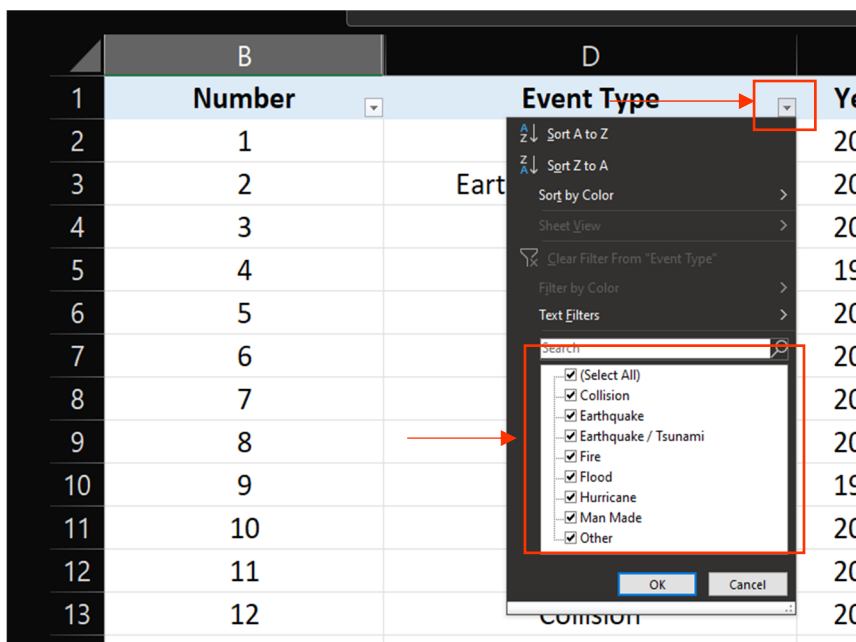
Figure 6-14. Using Built-In Filters in Excel to Navigate the CST Directory

6.3.2.2 Searching for a Specific Case Study in the File Directory

To search for a specific case study, users open the **file directory** and select the *Generated_CaseStudies* folder (Figure 6-15). This opens a series of files that are organized by event type. Users select the desired event type file from the list. From here, users select the PDF they want to view from the list (Figure 6-16). The case studies are listed by the case study name.
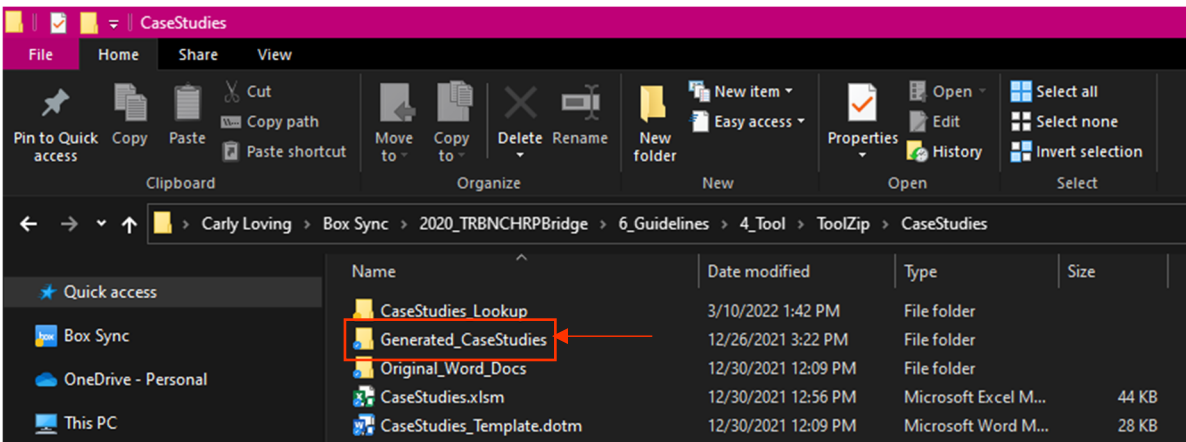
Figure 6-15. Viewing a Specific Case Study from the File Directory
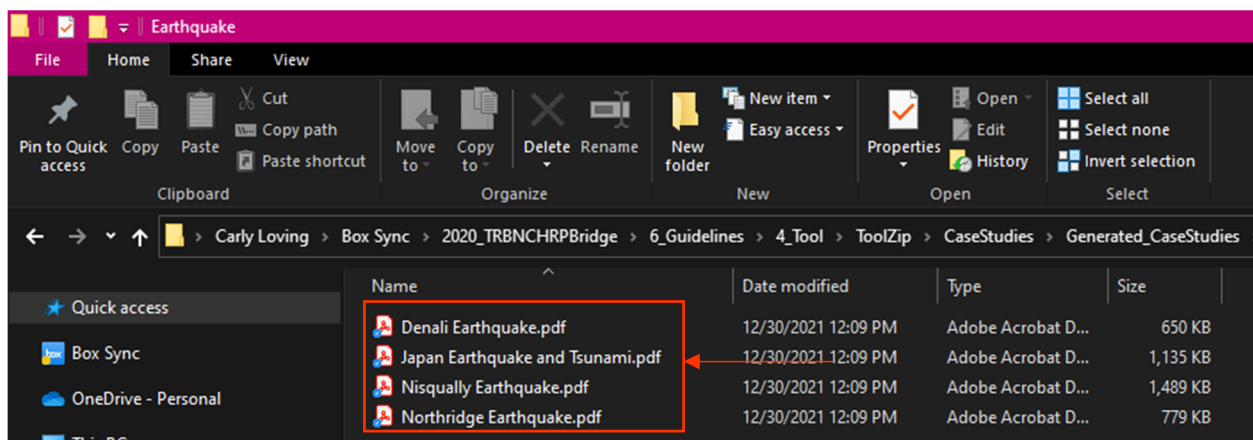
Figure 6-16. Viewing a Specific Case Study

To view the word document version of the case studies, users instead click on the *Original_Word_Docs* folder in the **file directory** (Figure 6-17). This folder contains all the Word documents of the default case studies, and are listed by the case study name.

6.4 Understanding the CST Output

When generating a new case study, the Excel template will output a Word document. Users can then edit the document to fill in the text below the generated headings. A sample completed case study is shown in Figure 6-18.

Once editing is complete, users are encouraged to save the Word document as a PDF. PDFs prevent unintentional editing when viewing existing case studies. The default case studies are saved as PDFs, and follow the same outline that is discussed below.

The main headings of the case study template and default case studies are described below.
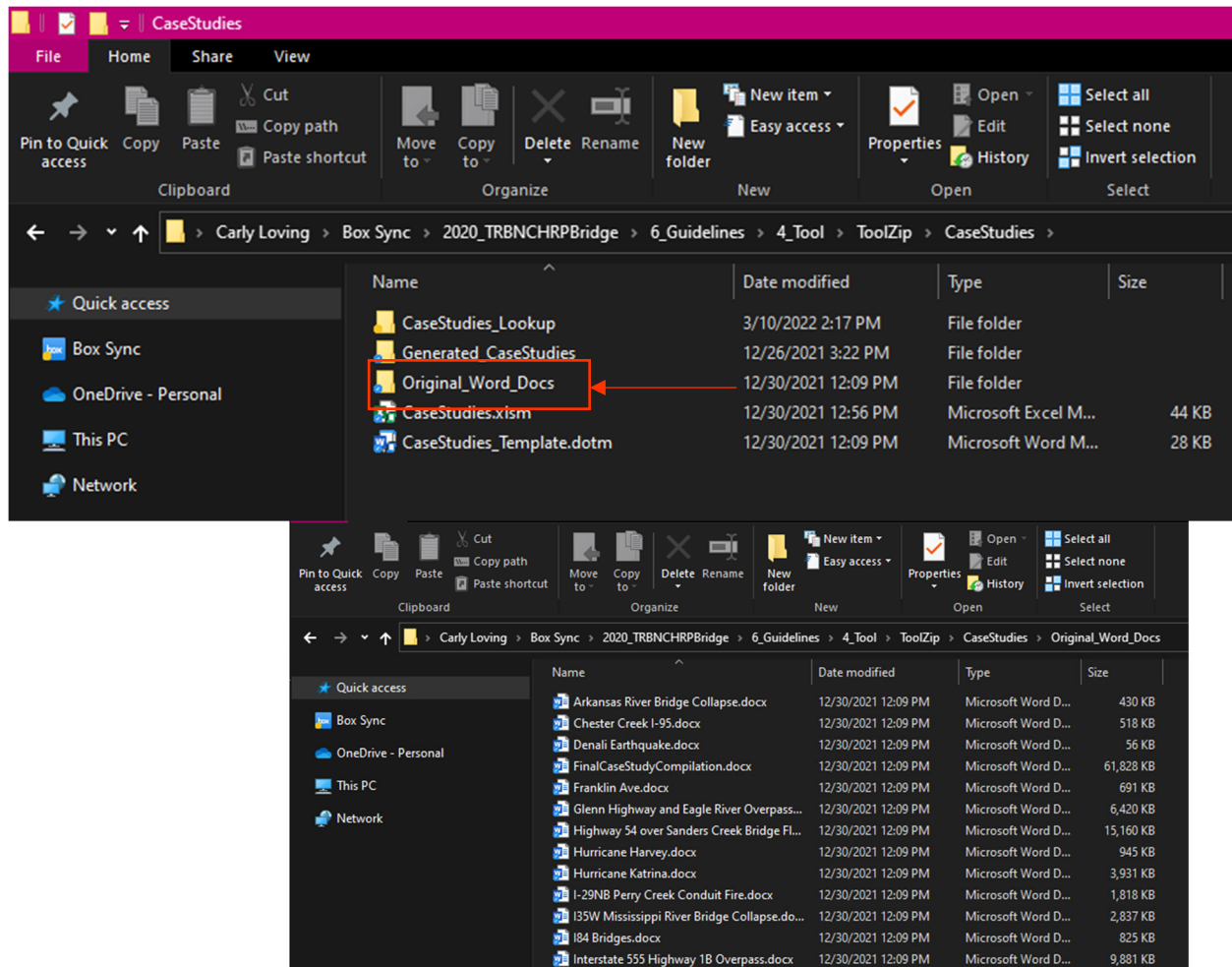
Figure 6-17. Viewing Original Case Study Word Documents

6.4.3 Summary

At the beginning of each Case Study, there is a summary table. This table includes the information that was directly inputted from the CST home page, which is the same information that is automatically inputted into the Case Study directory. The goal of this table is to provide a brief overview of the Case Study to allow users to decide if the case study warrants a closer look for their current research.

This summary table can be edited directly from the Word document but is highly discouraged because this information will not be automatically updated to the Excel directory. As a result, users will have to manually update the directory if they are interested in keeping this content up to date.

6.4.4 Introduction

This section is intentionally left blank with the CST home page inputs, along with the following sections. Users can add more information that describes the content that was inserted into the table and add any other pertinent information. The introduction section is meant to introduce the emergency event, give an overview of the challenges and solutions, and provide any background content. This section also contains a subsection entitled *Event Response*, which captures the actions that occurred outside the scope of many bridge

engineers – the first responders arriving on scene, the initial decisions made to either close the structure, establish detours, install temporary solutions, etc. This section details these not necessarily engineering related actions that are still important to understand, as they provide more reasoning behind why certain engineering decisions were made.

6.4.5 Emergency Planning

Similar to the *Introduction* section, this section is also intentionally left blank. This idea behind the *Emergency Planning* section is to outline any preparatory actions the State DOTs took that aided in the emergency response, assessment, or rapid restoration of the project. Examples include stockpiling temporary structures such as a Bailey Bridge, or establishing detours reroutes around major structures in the event of an incident. These planning actions may also stem from advanced warning, such as closing structures in storm paths before a flooding worsens or using a contraflow to evacuate citizens in the path of a hurricane. These actions not only saved the lives of the public, but also helped the State DOTs prepare for the emergency event.

6.4.6 Assessment

The *Assessment* section focuses on the methods used during the emergency assessment of the structure. This goes more in depth on the items listed in the summary table, such as why these method(s) were chosen, what were the extenuating circumstances, and what were the findings. In many cases, the assessment might have been as simple as a visual inspection, but it is still important to note what techniques were used to fully understand the information that was available at the time to reach the decision that was made.

6.4.7 Rapid Restoration

The *Rapid Restoration* section describes the repairs (or replacement) that was used to reestablish service. These methods may be temporary and were replaced with permanent solutions later – even after service was reestablished, or it may be an immediate long-term repair. In either case, these details can be outlined in the following subsections: contracting, design, procurement, temporary structure, and permanent structure. Not all these sections may be applicable, and can be removed as necessary. These pre-established headings are meant to guide transportation agencies on the information that is most beneficial to be aware of when looking back at the case study as a reference.

6.4.8 Challenges

The *Challenges* section outlines the key obstacles that were discovered throughout the emergency event. These challenges may be within any of the three main phases of planning, assessment, and rapid restoration, or they may be more focused on the event response, balancing expectations of multiple agencies or the public, and other social interactions. The challenges, and their corresponding solutions, are valuable when looking back on a case study.

6.4.9 Innovations and Lessons Learned

This section focuses on identifying the key takeaways from the project. Each bullet point listed in the summary table should be a heading in this section, and the subsequent paragraphs are meant to provide more content and detail to this list.

6.4.10 Sources

This section is where citations for any information used in the above section should be stored. These references could be other State DOT final reports, photos, news articles, or other similar information. If this information is all from one person's recollection, it is recommended to list that person as the main contact in the summary table, and make to note that again in the *Sources* section.

7 Case Study #7 – I-69 Southbound Bridge Hurricane Harvey

Table 7-1

Case Study Name/Date	I-69 Southbound Bridge Hurricane Harvey (2017)
Event Type	Hurricane
Bridge Name	I-69 Southbound Bridge
Bridge Type	Concrete
Scope	3 Bents repaired and 4 Spans replaced
Cost	Estimated total cost $7.5 million
Planning Techniques/Tools	N/A
Event Response	Traffic rerouted to Northbound Bridge during construction
Assessment Techniques/Tools	• Fish Finder-like device • Visual Inspection • Acoustic Imaging
Rapid Restoration Type	Precast beams and panels
Innovations	• Incentives/disincentives for early completion or late finish

7.1 Introduction

Hurricane Harvey dumped over 19 trillion gallons of water over Texas in 2017. This massive quantity of water flooded cities and even changed the course of some rivers, like in the case of the San Jacinto River near Humble, TX. The San Jacinto River deepened, leading to extreme scour of the I-69 Southbound Bridge, as shown in Figure 7-1. The structure was unable to carry typical freeway loads due to the unstable substructure, so it was closed after Hurricane Harvey for crews to remove and rebuild the scour damaged bents and their corresponding spans (Figure 7-2). The $7.5 million project used precast concrete beams and panels, with equipment brought to the site via barge. The project was completed in 182 days, which was ahead of schedule (Tobia 2018). Overall, the repair was the largest bridge construction project following Hurricane Harvey (Poirier 2018).

Figure 7-1. San Jacinto River Flooding Over I-69 (Kirk 2018)

7.1.1 Event Response

While the Southbound Bridge was closed for construction, traffic was rerouted to the Northbound Bridge, which was reconfigured to accommodate traffic in both directions. This kept traffic flowing during repair and limited the disruption to commerce (Delaughter 2018).

Figure 7-2. Scour Damage at Bent (Padgett et al. 2020b)

Figure 6-18. Sample Case Study Output (first page only)

6.5 Editing CST Excel Workbook Content

6.5.1 Excel Worksheet Database Overview

When creating a new CST, users can input the details of the case study. With these inputs, CST copies the information to a Word document that serves as a template for case study by filling in the summary table on the first page and adding headings. To create this template, the Excel database consists of a worksheet that stores the information users enter. This information is then copied to the CST directory and into the CST Word document template.

To edit the content within CST, developers first open the CST workbook. By default, only the CaseStudies worksheet is visible. To edit the Excel workbook, the Output and Type worksheets need to be unhidden. To open the additional worksheets, developers right click on the *CaseStudies* tab at the bottom of the workbook and then select *unhide*. A popup window will appear, and developers select the Output and Type worksheets to unhide, and then click *ok* when finished (Figure). To select multiple worksheets, press and hold the *ctrl* button on the keyboard while selecting the worksheets. The content of each worksheet is discussed in the following sections.
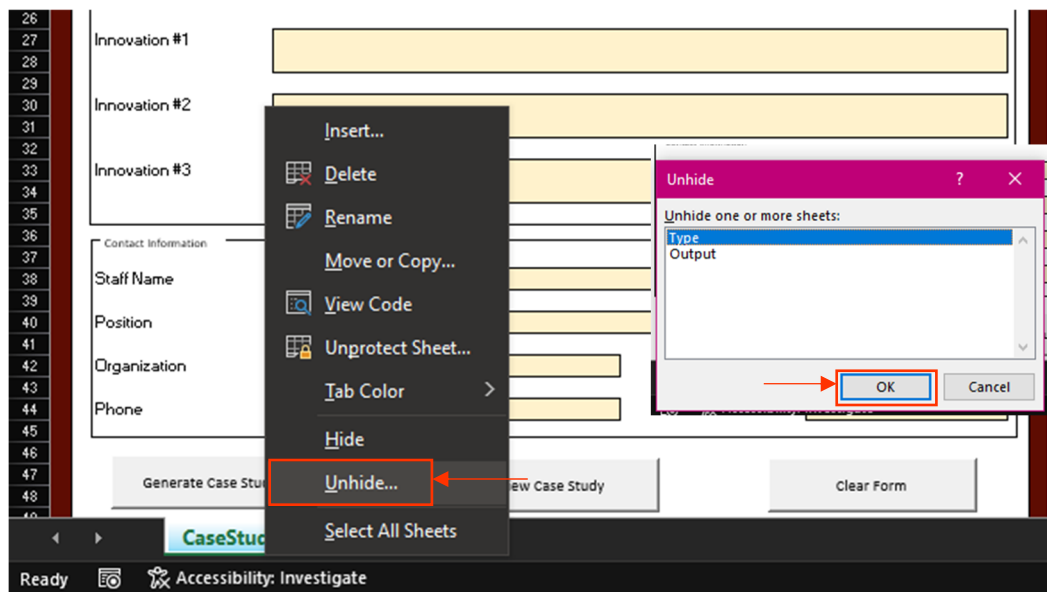
Figure 6-19. Opening Hidden Worksheet in the CST Workbook

Type

Overview

The Type worksheet is used to program the event combo box on the CST worksheet (Figure 6-21).

Editing

Developers can edit the event types by renaming the types listed on the Type worksheet in the green region of Column A (Figure 6-20). If developers want to add additional event types beyond the green region, then the VBA code will need to be edited.

Figure 6-20. Editing Event Types from the Type Worksheet

Output

Overview

The Output worksheet records all the inputs collected on the CST worksheet. The Output worksheet also copies the pertinent information to the CST Directory and the output Word document.

Output Generation

The Word document output is generated using a pre-developed template shown in Figure 6-22 and Figure 6-24. This template includes a series of placeholders that are exchanged for the generated content using a series of find and replace commands with the VBA code. In the corresponding section of the template, the specific placeholder is searched and replaced with the text in the Output worksheet in Excel. The code runs through all of the placeholders in the document, and then saves the file as a Word document in the subfolder that corresponds to the event type. During this process, the information on the Output worksheet in Excel is also copied to the CST directory. The CST directory can be accessed from the **BARRT file directory**, where users can search for past generated Case Studies or filter documents by event type.

Figure 6-21. Event Type is Controlled by Type Worksheet

Figure 6-22. CST Template – Page 1

6.6 Editing CST Word Document Template

The Word template (Figure 6-22 and Figure 6-24) used by CST to generate the Word document output can be edited as desired. To edit the template, developers can open the Word template from the **EEAP file**
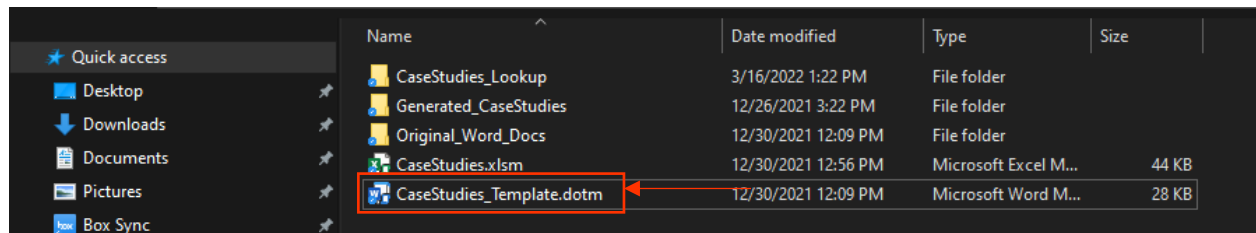
Figure 6-23. Opening CST Word Template from CST File Directory

directory and clicking on **CaseStudies_Template.dotx** (Figure 6-23).

1 Introduction

1.1 Event Response

2 Emergency Planning

2.1 Crowdsourcing and Information Gathering

3 Assessment

4 Rapid Restoration

4.1 Contracting

4.2 Design

4.3 Procurement

4.4 Temporary Structure

4.5 Permanent Structure

5 Challenges

6 Innovations and Lessons Learned

6.1 Key Point 1

6.2 Key Point 2

6.3 Key Point 3

6.4 Key Point 4

6.5 Key Point 5…

7 Sources

Figure 6-24. CST Template – Page 2

With the template opens, developers can edit any of the text that does not have a "#" in front of it. The "#" symbol is used by the VBA code to copy the data from the Output worksheet of the CST Workbook and paste it into the Word document. The formatting of the table and the headings can be altered as long as the "#" tagged text remains the same, the VBA code will not need to be adjusted.

The CST Template includes a filled in summary table on page 1 and a series of automatically generated headings on page 2. These headings are consistent with the headings used in the preloaded Case Studies within CST. Users or developers can complete the case studies by adding descriptions to the headings to provide more details about the case studies. It is encouraged that users and developers add in photos, tables, and additional information that will record the information that futures users will find helpful.

Once the desired formatting and text is updated in the template, developers will need to save the template as a new template by going to the *file* tab and clicking *save as* (Figure 6-25). Then developers click *browse*
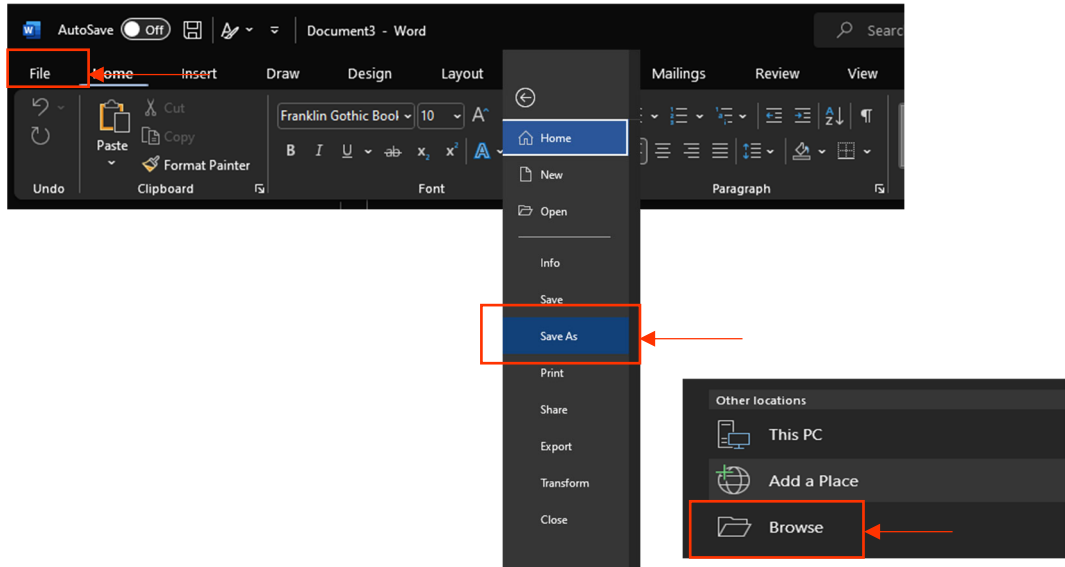
Figure 6-25. Saving the Updated Word Template via "Save As"

and navigate to the **CST file directory**.

Then, the name of the template needs to be entered as: **CaseStudies_Template1.dotx**. The file name cannot be **CST_Template.dotx** as that is the name of the original template, and Microsoft Word is unable to overwrite this existing file. The file type also needs to be changed to a *Macro Enabled Word Template (**.dotm)* from the drop-down menu under *save as type* (Figure 6-26). Lastly, the document can be saved by clicking *save* (Figure 6-27)*.

From the **CST file directory**, the original **CST_Template.dotx** file can be deleted, and the newly created
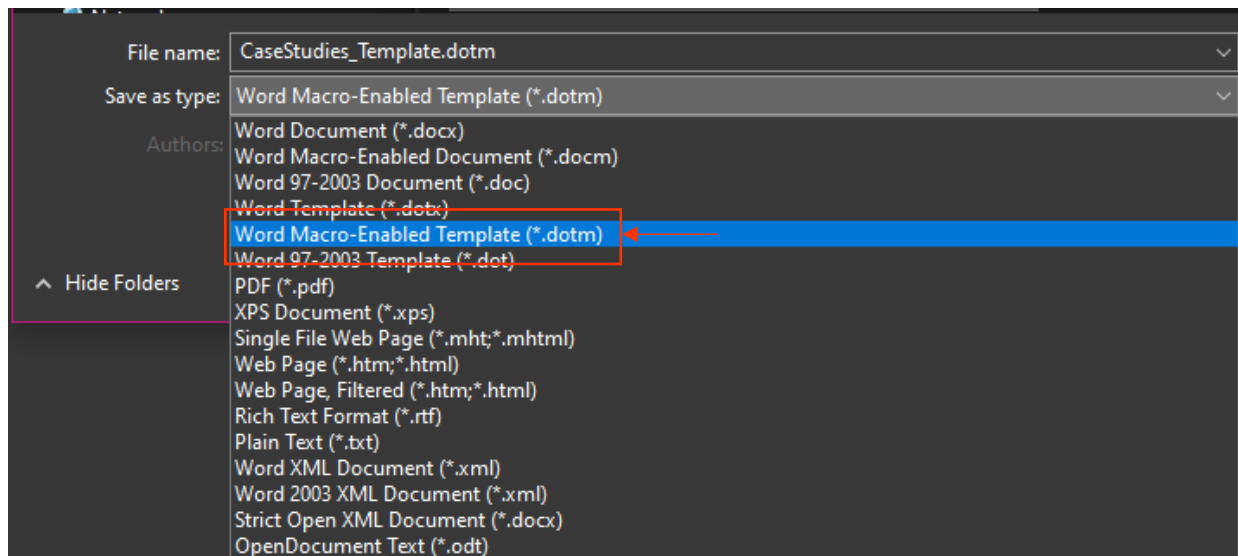
Figure 6-26. Changing the File Type to a Word Template

CST_Template1.dotx file must be renamed to **CST_Template.dotx**, as this is the name that the VBA code expects. To rename the template, developers can right click on the file, select rename, and remove the "*1*" in the file name.
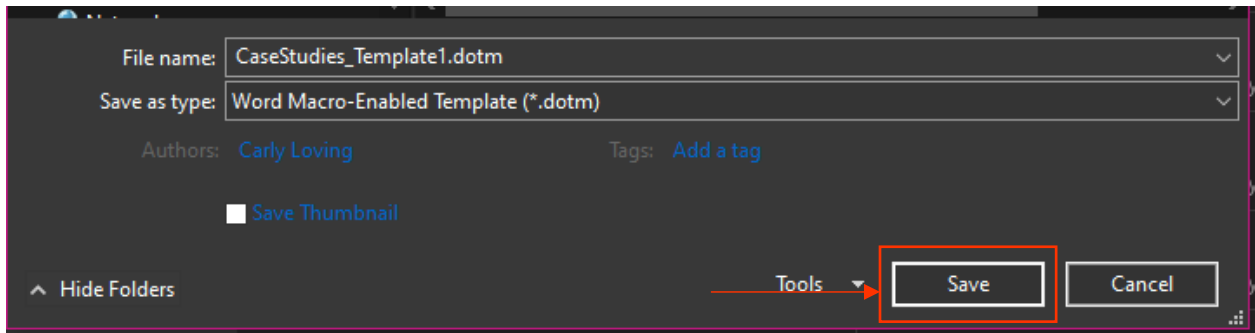
Figure 6-27. Saving the Edited CST Template File as "CaseStudies_Template1.dotx"

Chapter 7: Status Form

7.1 Overview

The Status Form is a Word document to quickly capture and share information with stakeholders. The Status Form is designed to serve as a memo-style document to organize emergency response information. Users first upload agency identifier information, edit the templates, and then distribute the document to key stakeholders (Figure 7-1). This chart organizes each structure by name and location, with columns to indicate the levels of inspection and coding/marking the structure completed.
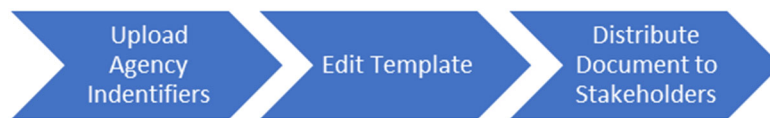
Figure 7-1. Status Form Flow

The Status Form can progress throughout the emergency event response process if agencies choose. The form can be used up through repairs if it continues to be updated. If users have their own templates for these phases, they can be uploaded to BARRT and used in exchange for the "default" Status Form. Instruction for how to customize the Status Form are covered in the *Developer Guide*.

7.2 Opening the Status Form

The Status Form can be accessed through the main interactive PowerPoint format of BARRT (recommended) or through the **file directory**. To open the Status Form from the BARRT PowerPoint, users click on the *Status Form* button which automatically opens the Status Form tool in Microsoft Excel (Figure 7-2).
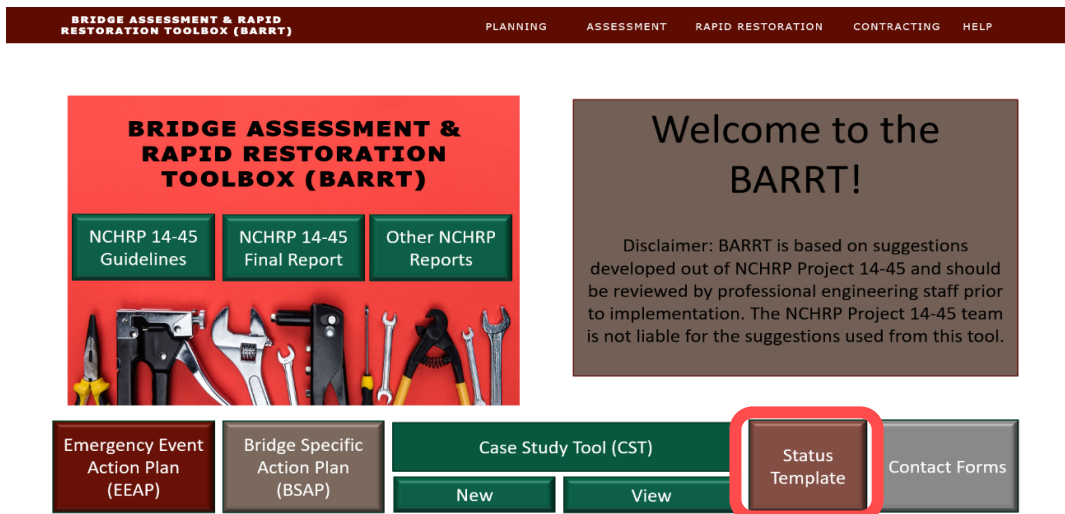
Figure 7-2. Accessing the Status Form from BARRT

Alternatively, users can go to the **file directory** and click on the **Status Form** folder, which opens the files required to run the Status Form. The Excel Workbook entitled **Template_StatusForm.xlsm** opens the Status Form Excel Platform (Figure 7-3).
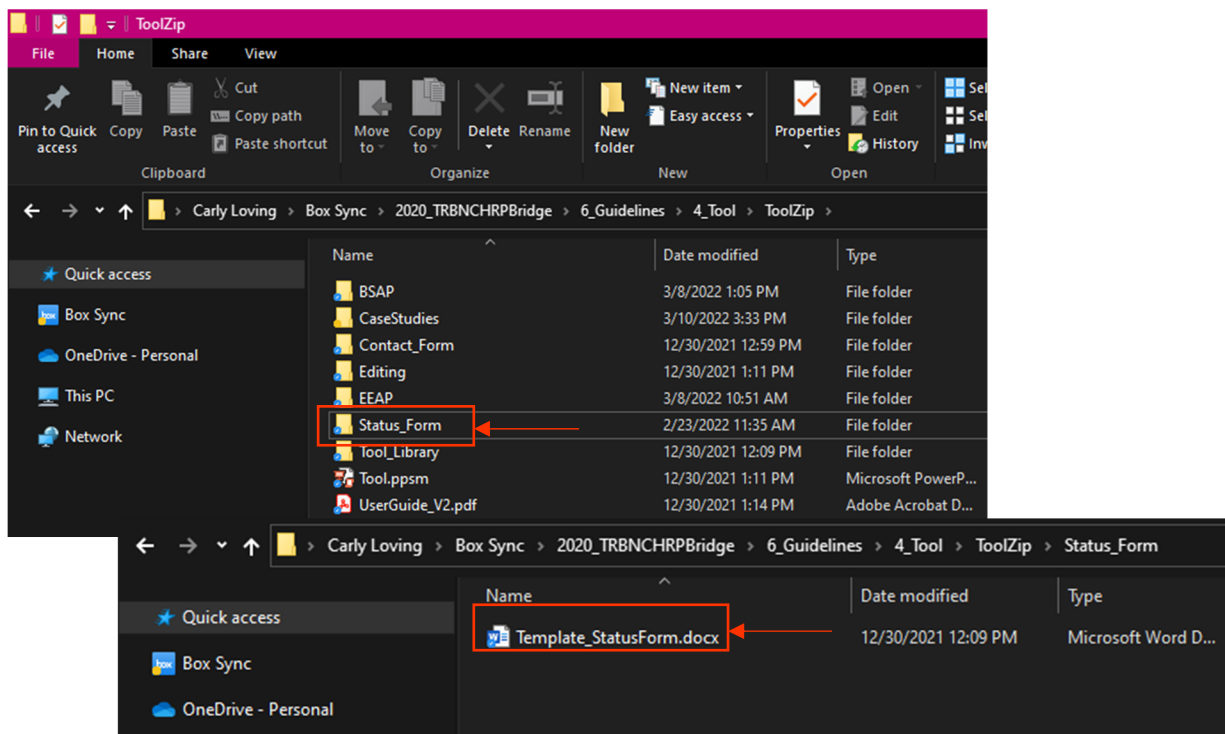
Figure 7-3. Opening Status Form from File Directory

7.3 How to Use the Status Form

The Status Form is laid out in five main sections: the memo heading, the memo, the update log, and additional details, and the structures status update (Figure 7-4). For each section, users can make edits to fit their specific needs directly within the Word document. Once edits are made, the update log should be filled out to reflect the changes made. Then the Status Form can be distributed to key stakeholders.

7.3.1 Memo

Users type in the desired memo content in this section.

INSERT YOUR AGENCY NAME HERE

INSET YOUR LOGO HERE

DATE:
TO:
FROM:

SUBJECT: [INCLUDE EVENT NAME AND UPDATE NUMBER]

Type Memo Here

UPDATE LOG

DATE	TIME	UPDATE

CURRENT OPERATIONS

Type Here

RESOURCES DEPLOYED

Type Here

OPTIONAL HEADING 1

Type Here

OPTIONAL HEADING 2

Type Here

OPTIONAL HEADING 3

Type Memo Here

Status Form – AGENCY NAME
1

Figure 7-4. Status Form Memo Template

7.3.2 Update Log

Depending on the extreme event, there may be multiple iterations of the Status Form. To keep track of edits, users should update the *update log* each time edits are made. The date, time, and general description of the update are included in the log.

7.3.3 Additional Details

For guidance, a series of headings are included below the *update log*. These can be changed based on the user needs. The *current operations* section outlines the general overview of work performed as either a bulleted list or paragraph form. This description will update with time as the response progresses from initial emergency response to assessment and repairs. The section below is r*esources deployed*, which outlines the staffing, materials, and funding used with the current operations. Similar to the c*urrent operations* section, this section should be updated as the operations change from emergency response to assessment and repairs. The remaining sections are left blank and can be updated by users to meet their needs.

7.3.4 Structures Status Update

The second page of the Status Form contains the *structure status update* table (Figure 7-5). This table organizes all structures within the impacted area and provides a place for users to denote the assessments and coding and marking completed. A description of the tabular inputs is outlined in Table 7-2.

STRUCTURE STATUS UPDATE

NAME	STRUCTURE NUMBER	LOCATION DESCRIPTION	STATUS	LOCATION	REGION	ASSESSMENTS COMPLETED				CODING/MARKING COMPLETED			TTC
						FR	PDA	DDA	EI	INSPECTED	LIMITED USE	UNSAFE	
				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									
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				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									
				Lat									
				Long									

Status Form – AGENCY NAME
2

Figure 7-5. Structure Status Update Table

Table 7-2. Inputs to Structure Status Update Table

Letter	Action	Notes
Name	Type in the name of the bridge	
Structure Number	Type in the structure number	
Location Description	Type in a description of the bridge location	This can include features crossed, mile post, or other identifying location features
Status	Type in the status of the bridge (Opened, Closed, Partial)	Opened: the structure is open to traffic Closed: the structure is closed – no traffic permitted Partial: traffic is restricted on the bridge
Location	Type in the latitude and longitude coordinates of the bridge	
Region	Type in the agency region	
Assessments Completed	Check off the assessment stages that are completed	FR: Fast Reconnaissance PDA: Preliminary Damage Assessment DDA: Detailed Damage Assessment EI: Extended Investigation
Coding/Marking Completed	Check off the Marking Classification of the bridge	Inspected: No apparent damage, structure can continue to function Limited Use: minor to moderate damage, restricted use until further evaluation Unsafe: severe damage or collapse. The bridge must be closed
TTC	Indicate if Temporary Traffic Control (TTC) is implemented	Structures that are restricted or closed should have temporary traffic control implemented. Structure that are fully open may or may not have TTC

7.4 Status Form User Example

To illustrate the proper use of the Status Form, an example is outlined herein. A hypothetical earthquake hits a particular region. The local agency uses the Status Form to share updates to their main stakeholders. On the first page, the agency outlines a general summary to its stakeholders about the current status of the response, as shown in Figure 7-6. Below this memo, the *update log* is completed to highlight previous versions of this document. The subject of the memo also includes the current update number. *Current operations* are listed below the update log, and includes more details than the initial memo summary.

DEPARTMENT OF TRANSPORTATION
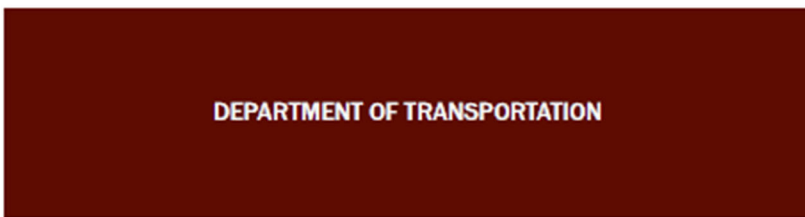
DATE: 19 MAY 2019
TO: MAIN STAKEHOLDERS
FROM: JOHN SMITH, TRANSPORTATION DIRECTOR

SUBJECT: MAJOR EARTHQUAKE 2019 – UPDATE NO. 4

Greetings,
In response to the Major Earthquake that struck the western region on Friday, May 12th, the Department of Transportation has been diligently working to remove debris, completed structural assessments, and begun preparations for repairing damaged structures.

All highway bridges have completed the fast reconnaissance, preliminary damage assessments, and detailed damaged assessments. Structures with severe damage are currently undergoing extended investigations where applicable.

The North Crossing Bridge has now reopened after a temporary Bailey Bridge was installed. Further inspections will determine the best repair practices for this bridge. The Interstate 12 over the Yellow River Bridge remains closed until an extended investigation assessment is completed.

Inspection personnel from nearby states are starting to return home. We are confident our agency can wrap up any final assessments with our own staff and nearby consultants.

Another update is expected for next Tuesday, May 23rd.

Thank you for your continued support on our path to recovery.

John Smith, PE

UPDATE LOG

DATE	TIME	UPDATE
5/19/19	10am (EST)	North Crossing Bridge Reopened; out of state agents have returned home
5/15/19	12pm (ESt)	All detailed damage assessments have been completed. The Yellow River Bridge, Main Street Bridge, and Long Street Viaduct are opened with load restrictions.
5/13/19	9:30am (EST)	Fast reconnaissance and preliminary damage assessments have been completed. Meadows Creek, Jackson Ave, and National Hill Bridge are reopened.
5/12/19	3:15pm (EST)	Inspectors from nearby states are enroute to aid in fast reconnaissance and preliminary damage assessments. All structures within a 25 miles radius are closed until assessments deem them safe.

CURRENT OPERATIONS

- All agency bridge inspectors are working on completing extended investigations on flagged infrastructure
- Orders have been placed for another Bailey Bridge from a nearby agency to temporarily replace the Interstate 12 Bridge
- Contracts for repair orders are being repaired for structures that are currently open

Figure 7-6. Example Status Form – Page 1

The *resources deployed* are also in a bulleted list. These include the quantities and a brief description. Lastly, the agency added a *contracts* section to highlight the use of on-call contracts and to inform stakeholders of the timeline for the contracts. These items are shown in Figure 7-7.

RESOURCES DEPLOYED

- Temporary Structures: (1) Bailey Bridge and (1) on the way
- Personnel: Bridge Inspection Teams 5- 9 completing all EIs. Teams 1-4 will trade off next Monday
- Equipment: (4) loaders and (2) rollers are in transit from Elliswood to prepare for approach repairs next week. All (12) inspector team kits are in the field

CONTRACTS

Consultants on the on-call contract have been notified of repairs that need to be completed. No contracts have been awarded, but are expected to go to bid next week.

Figure 7-7. Example Status Form – Page 2

The last page of the Status Form includes the *structure status update*, which lists all the bridges impacted by the earthquake. The leftmost columns are filled out with identifying information like name, number, and location, as shown in Figure 7-8. A location description is included along with the latitude and longitude in case initial responders are not able to discern the coordinates. The status, assessments completed, and coding/marking completed are updated as the situation evolves. In the case of the North Crossing Bridge, the status is marked as "opened" despite the structure being coded as "unsafe". This is because a temporary Bailey Bridge was installed at this location (as described in the memo on page 1), so traffic is restored, but the original structure will still need to be repaired or replaced. In the far column, it is indicated that temporary traffic control is deployed at the structures were applicable (naming the structures that are closed or are opened with a limited capacity).

The Status Form for this example will continue to be updated as the situation progresses and the agency adjusts their response.

STRUCTURE STATUS UPDATE

NAME	STRUCTURE NUMBER	LOCATION DESCRIPTION	STATUS	LOCATION		REGION	ASSESSMENTS COMPLETED				CODING/MARKING COMPLETED			TTC
							FR	PDA	DDA	EI	INSPECTED	LIMITED USE	UNSAFE	
North Crossing Bridge	01564A	Crosses Hilltop Road	Open	Lat 44.5635 N	Long 123.2793 W	4	X	X	X				X	
Yellow River Bridge	300562	Second Street over the Yellow River	Restricted	Lat 44.5620 N	Long 123.1865 W	4	X	X	X			X		X
Main Street Bridge	987698	Main Street over 14th Ave	Restricted	Lat 44.5589 N	Long 123.5986 W	4	X	X	X			X		X
Long Street Viaduct	02564B	Long Street over Lucky Channel	Restricted	Lat 44.56486 N	Long 123.6985 W	4	X	X	X			X		X
Meadows Creek Bridge	035697	Highway 45 over Meadows Creek	Open	Lat 44.51756 N	Long 122.0264 W	3	X	X			X			
Jackson Ave Bridge	301235	Jackson Ave over Hillshire Road	Open	Lat 44.56306 N	Long 123.2236 W	4	X	X			X			
National Hill Bridge	306897	Glencoe Street over Marshall Road	Open	Lat 44.6134 N	Long 122.1596 W	3	X	X			X			
Interstate 12 Bridge	014458	Interstate 12 over the Yellow River	Closed	Lat 44.5699 N	Long 123.5745 W	4	X	X	X				X	X
				Lat	Long									
				Lat	Long									
				Lat	Long									

Figure 7-8. Example Status Form – Page 3

7.5 Editing Word Document Content

The Status Form Word document can be edited to meet the need of State DOTs. Developers can update logos, headings, tables, and other elements of the document freely, as there is not VBA code for this form generation (Figure 7-9). It is recommended that any tables (such as the Structure Status Update Table on page 2 of the Status Form, Figure 7-10) be converted to Excel to permit easy sorting and filtering. Developers could then link this Excel workbook to the Word document using their own VBA coding. VBA code could also be added to link fast reconnaissance, preliminary damage assessment, detailed damage assessment, and extended investigation for State DOTs to the check boxes to open the documents or PDFs that contain these forms.

Figure 7-9. Status Form Template – Page 1

Figure 7-10. Status Form Template – Page 2

7.6 Uploading a New Status Form Template

If State DOTs wish to have their own version of the Status Form, developers can upload that version to the **Status Form file directory** and BARRT PowerPoint. To upload the template (or templates), developers first navigate to the **Status_Form** folder in the **BARRT directory** and then save the file(s) or (folders) here (Figure 7-11).

Figure 7-11. Save New Status Forms in the Status_Form Folder in the BARRT Directory

To add the newly updated file(s) or folder(s) to the BARRT PowerPoint, developers can open the BARRT PowerPoint file by browsing to the **Editing** folder in **the BARRT directory** and opening the **Tool.pptx** file (Figure 7-12). On the BARRT main page (slide 1), developers click on the *Status Template* button to select it, right click on the button, and select *edit link* to open the edit hyperlink popup. If multiple files or folders make up the new Status Form Template, developers should select the root folder that contains all of the files (or all of the folders). When clicked on, the *Status Form* button will use Windows File Explorer to open the root folder for users to select the desired file or folder. Additionally, new buttons can be added to the BARRT main page for each folder or file.
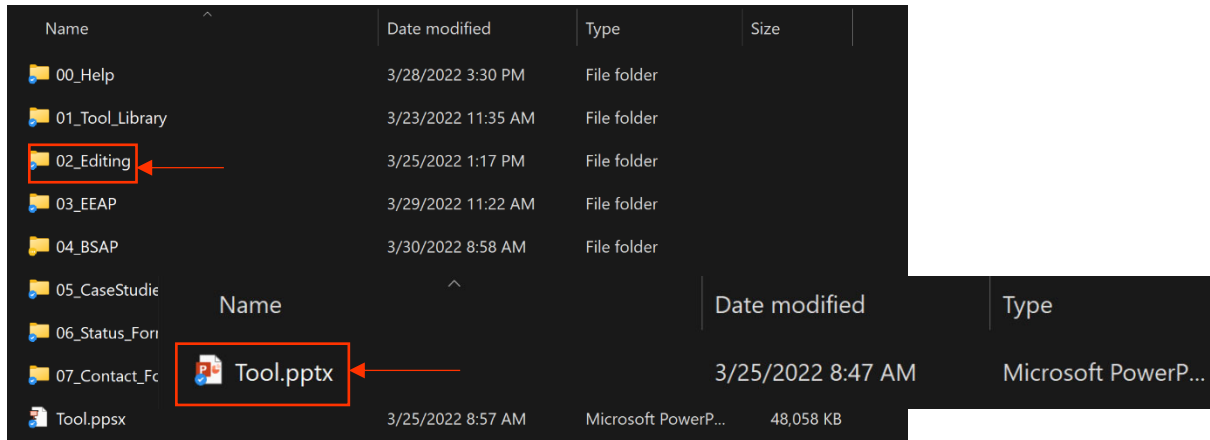
Figure 7-12. Opening the BARRT PowerPoint Presentation

Chapter 8: Contact Form

8.1 Overview

The Contact Form is an Excel spreadsheet for users to organize their important contacts to share internally and externally with other agencies. In future applications, this form could serve as the primary input for a national database where State DOTs can upload their contact information to a single location. Individual State DOTs are responsible for keeping their agency's contact information up to date.

Once users open the Contact Form workbook, they will browse the four main headings: general, primary call list, bridge groups, and management – to help find the job title of interest. If the agency has a different job title than what is listed, the title can be edited, or additional rows can be added. Contact information then be typed into the listed fields. From here, users can send the updated Contact Form to internal and external agency contacts as part of extreme event preparation.

8.2 Opening the Contact Form

The Contact Form can be accessed through the main interactive PowerPoint format of BARRT (recommended) or through the **file directory**. To open the Contact Form from the BARRT PowerPoint, users simply click on the *Contact Form* button which automatically opens the Contact Form tool in Microsoft Excel (Figure 8-1).
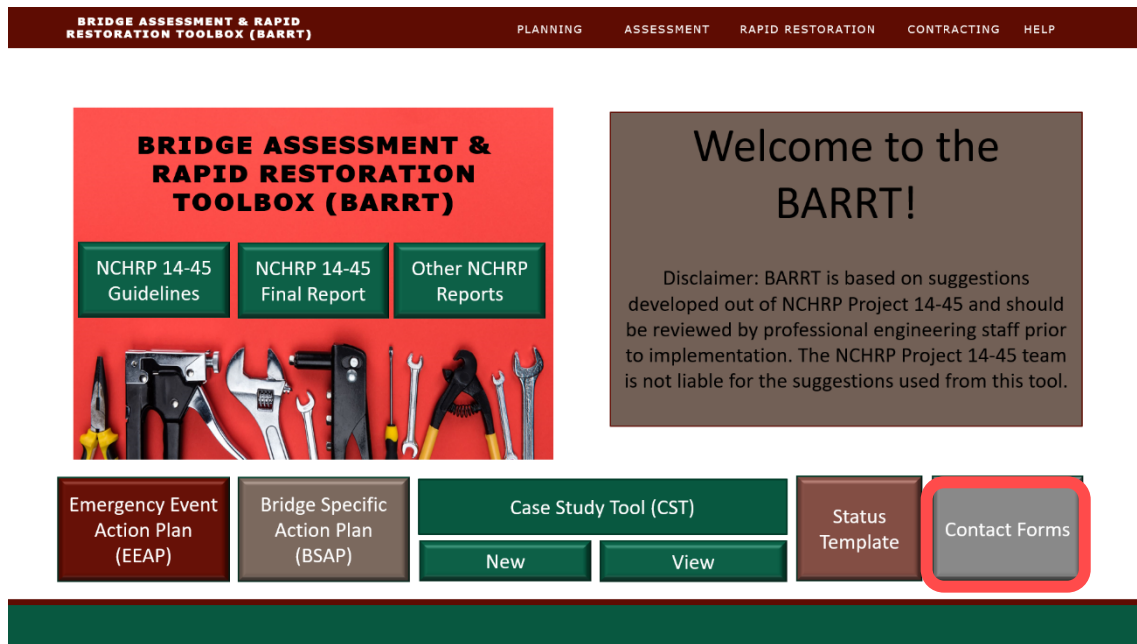
Figure 8-1. Accessing the Contact Form tool from BARRT

Alternatively, users can navigate to the **file directory** and click on the **Contact Form** folder, which opens the files required to run the Contact Form. The Excel Workbook entitled **Contact_Form.xlsm** opens the Contact Form Excel Platform (Figure 8-2).
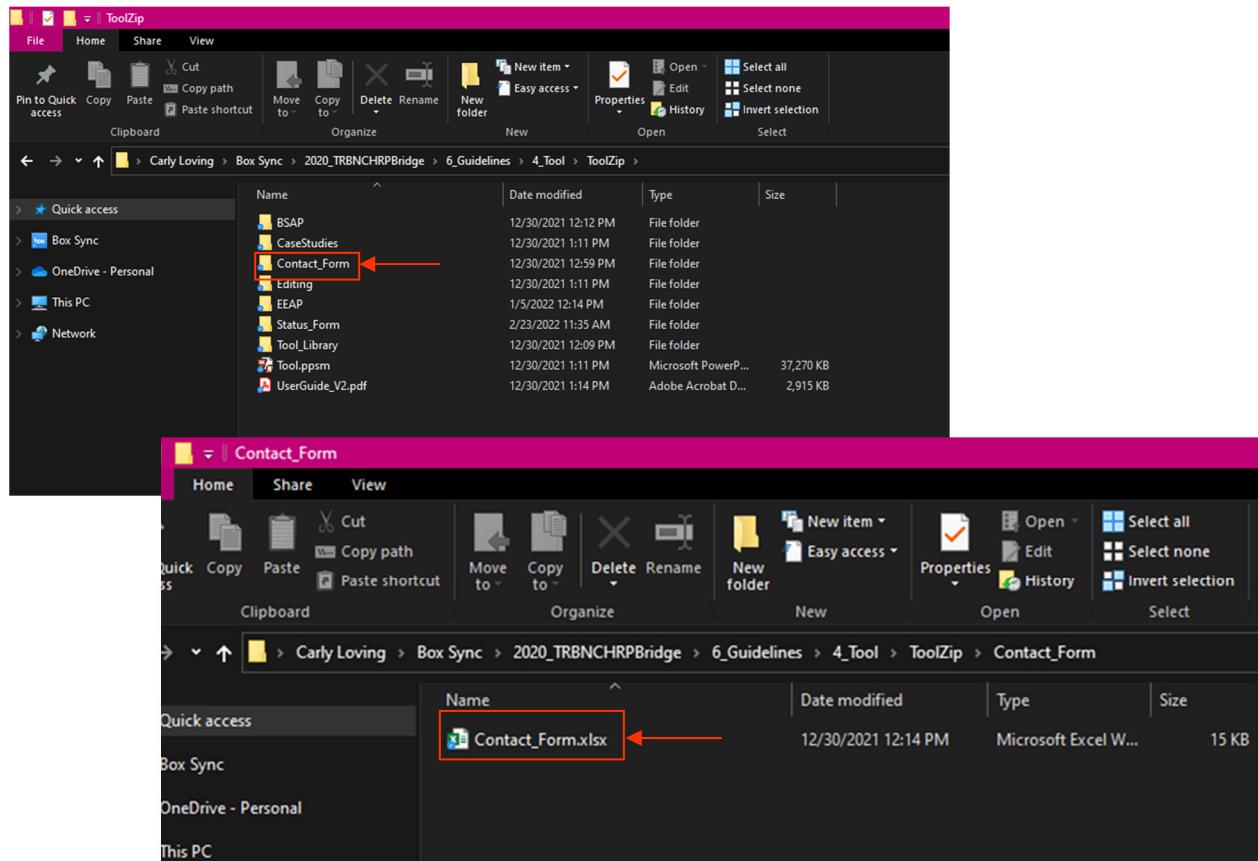
Figure 8-2. Opening the Contact Form from File Directory

8.3 How it Works

The Contact Form template is an Excel spreadsheet organized into three main sections: general, bridge groups, and management. Users locate (or add their own) the desired job title, then type in the name, region/district, office number, cell number, and email address for the employee. When changes arise, agencies should update the form.

On the Contact Form, there is space for contact information for the state emergency operation centers and regional offices (Figure 8-3). Emergency operation centers may be established on an ad hoc basis, so these centers may not have permanent phone numbers. Thus, contacts for individual command centers are not listed; instead, the state command center and each agency regional office is listed. The agency's specific Federal Highway Administration (FHWA) contact should also be included, and if a local agency does not have a contact, they are encouraged to reach out to the state agency for that information.

The following sections outline the three main section on the Contract Form and provide details for what information to include.

CONTACT FORM				
General:				
Structures Division (Main Number)	Phone #	(888) 999-0000	Name	
	Cell #			
	Email		Region/District	
Traffic Operations Center (TOC)	Phone #		Name	
	Cell #			
	Email		Region/District	
State Emergency Command Center	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 1	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 2	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 3	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 4	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 5	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 6	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 7	Phone #		Name	
	Cell #			
	Email		Region/District	
Region 8	Phone #		Name	
	Cell #			
	Email		Region/District	
Seismology Station	Phone #		Name	
	Cell #			
	Email		Region/District	
FHWA Contact	Phone #		Name	
	Cell #			
	Email		Region/District	

Figure 8-3. Contact Form – General

8.3.1 Primary Call List

The primary call list (Figure 8-4) includes a priority list of individuals that should be first contacted during an emergency event. These individuals may be from the state or local agency. The primary call list may not be the same group contacted during event response or assessments, but should be contacted initially to notify about the impending or ongoing emergency event.

8.3.2 Bridge Groups

The bridge groups list (Figure 8-5) contains staff that are based out of the bridge (or similar) group and should be contacted for technical knowledge. Multiple engineers should be listed for each job to provide redundancy with planning and a wide range of expertise. If desired, engineers from each agency district or region can be listed.

8.3.3 Management

Management should only be contacted for response levels III and IV emergencies. This list of personnel includes regional directors and engineering staff outside of the structural bridge sections, such as

geotechnical engineers and hydraulic engineers (Figure 8-4). In some situations, the multidisciplinary technical experts may need to be called upon for advice and planning, but otherwise these folks should only be contacted in extreme situations.

Primary Call List:				
Bridge Emergency/ Maintenance Coordinator	Phone #	(888) 999-0000	Name	
	Cell #			
	Email		Region/District	
Structures Bridge Management Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Structures Project Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Structures Design Manager	Phone #		Name	
	Cell #			
	Email		Region/District	
Chief Structural Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	

Figure 8-4. Contact Form – Primary Call List

Bridge Groups:				
Bridge Inspection Supervisior	Phone #	(888) 999-0000	Name	
	Cell #			
	Email		Region/District	
Bridge Inspector	Phone #		Name	
	Cell #			
	Email		Region/District	
Bridge Inspector	Phone #		Name	
	Cell #			
	Email		Region/District	
Bridge Inspector	Phone #		Name	
	Cell #			
	Email		Region/District	
Senior Design Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Design Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Bridge Program Manager	Phone #		Name	
	Cell #			
	Email		Region/District	
Bridge Planning Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Structures Construction Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Senior Design Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Design Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Design Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Load Rating Engineer	Phone #		Name	
	Cell #			
	Email		Region/District	
Engineering Technician	Phone #		Name	
	Cell #			
	Email		Region/District	

Figure 8-5. Contact Form – Bridge Groups

8.4 Editing Contact Form Excel Workbook Content

Developers can make edits directory to the Contact Form Excel workbook, as there are no VBA controlled macros in this workbook. Additional contact information, positions, and details can be added to meet the needs of State DOTs (Figure 8-6).

Figure 8-6. Editing the Contact Form

8.5 Uploading a New Contact Form

If State DOTs have their own version of the Contact Form, developers can upload this to the **Contact Form file directory** and BARRT PowerPoint. To upload the template (or templates), developers first navigate to the **Contact_Form** folder in the **BARRT directory**, then save the file(s) or (folders) here (Figure 8-7).
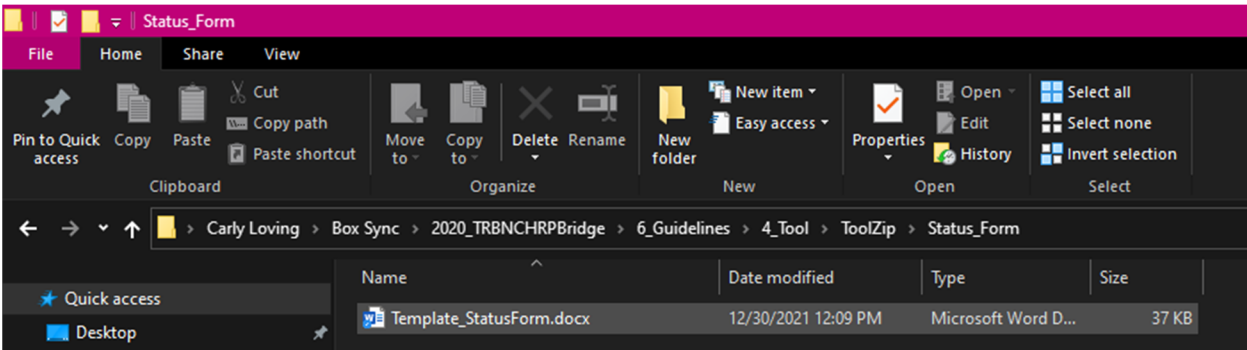
Figure 8-7. Save New Status Forms in the Contact_Form Folder in the BARRT Directory

To add the newly updated file(s) or folder(s) to the BARRT PowerPoint, developers can open the BARRT PowerPoint file by browsing to the **Editing** folder in the **BARRT directory** and opening the **Tool.pptx** file (Figure 8-8). On the BARRT main page (slide 1), developers click on the *Contact Form* button to select it, then right click on the button and select *edit link* to open the edit hyperlink popup. If multiple files or folders make up the new Contact Form Template, developers should select the root folder that contains all of the files (or all of the folders). When clicked on, the *Contact Form* button will use Windows File Explorer to open the root folder for users to select the desired file or folder. Additionally, new buttons can be added to the BARRT main page for each folder or file.
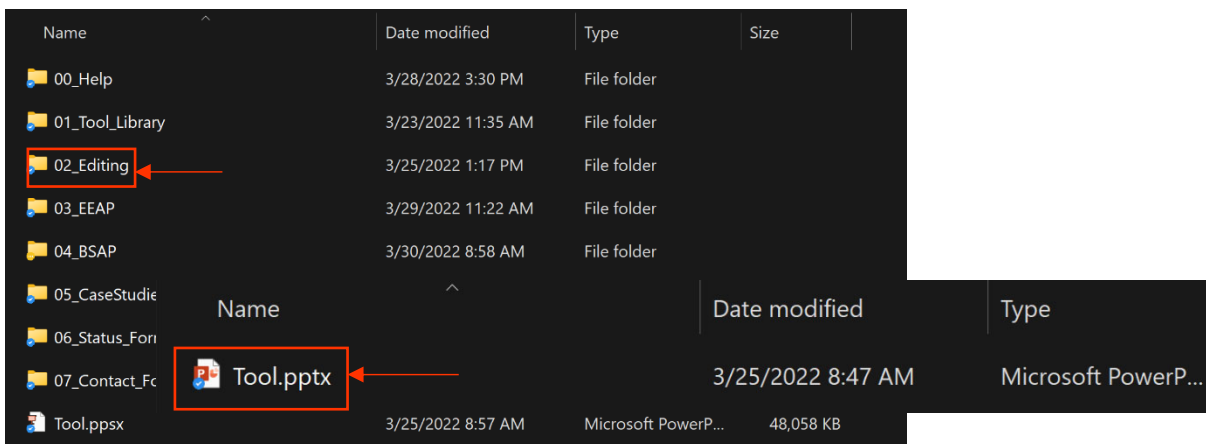
Figure 8-8. Opening the BARRT PowerPoint Presentation

Chapter 9: BARRT Customization with Visual Basic for Applications (VBA)

9.1 Enabling Visual Basic for Applications (VBA)

Developers can customize many features within BARRT by simply editing text in Word, PowerPoint, and Excel. However, for extensive changes or expanded functionality, developers may need to make edits to the visual basic for applications (VBA) code. VBA can be used to write and operate macros in Microsoft Office. Depending on their device, developers may need to turn on VBA editing capabilities by showing the *Developer* ribbon in their Microsoft Office settings.

To display the *Developer* ribbon, developers should open Word or Excel. VBA is not used to run the Interactive PowerPoint. Developers first click on *file,* then select *options,* and then *customize ribbon* (Figure 9-1) to launch a popup window that shows a listing of all ribbons in the program. Select *main tabs* and check the box next to *Developer.* This adds the *Developer* ribbon to the specific Microsoft Office product. Developers select *ok* to close to popup (Figure 9-2). This process should be repeated for two Office products: Word and Excel.
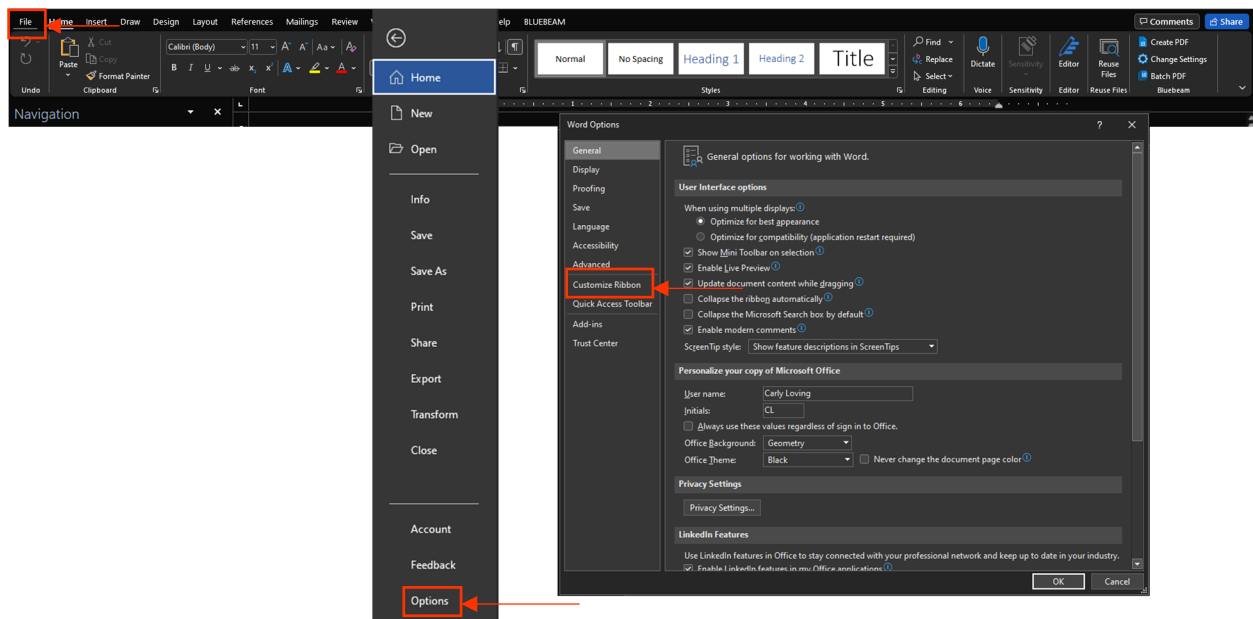
Figure 9-1. Customizing the Microsoft Office Ribbon

To open the VBA editor, developers open the *Developer* ribbon in either Word or Excel, and then click on *Visual Basic* (Figure 9-3). This opens a popup window that contains the VBA editor (Figure 9-4). Alt-F11 is a keyboard shortcut to open the VBA editor.
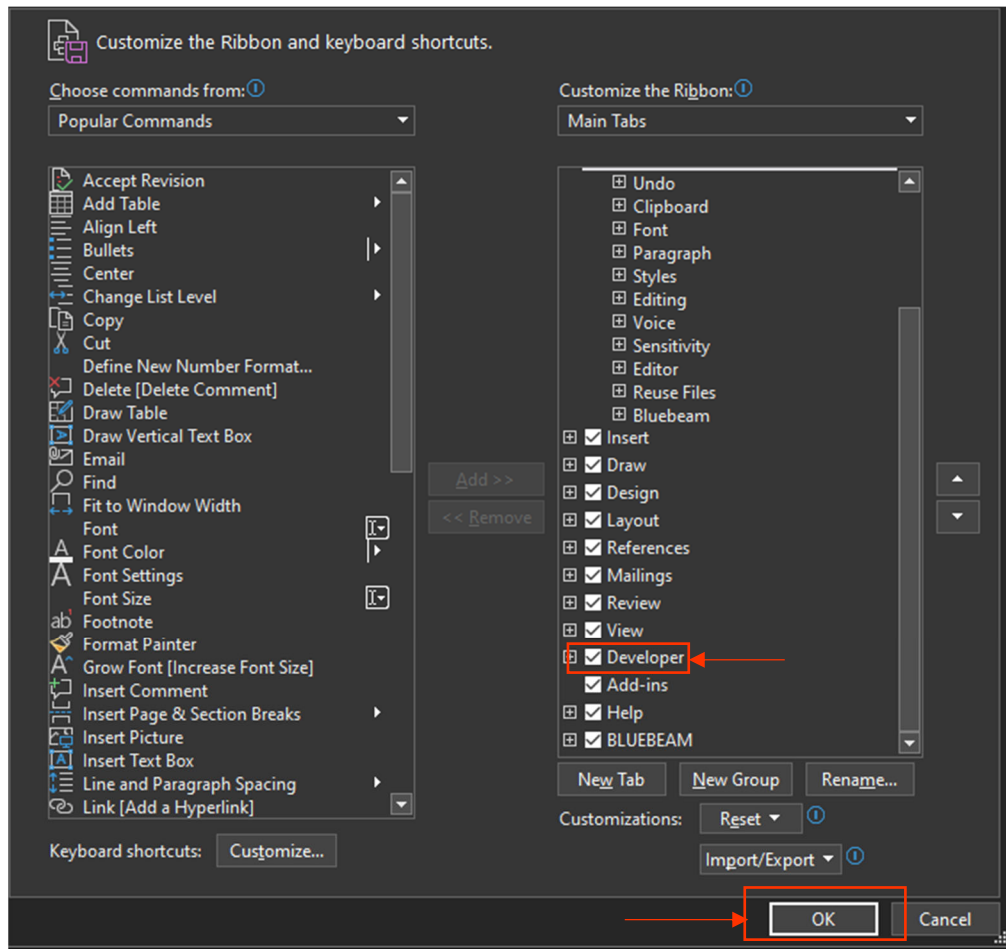
Figure 9-2. Turning on the Developer Ribbon in Microsoft Office
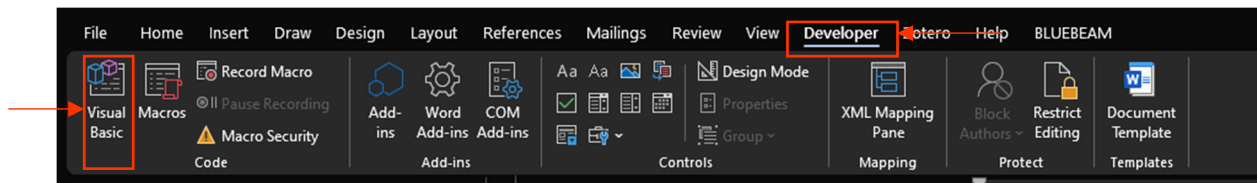
Figure 9-3. Opening the VBA Editor from the Developer Ribbon

With the VBA Editor open, developers need to first ensure that the correct VBA object libraries are enabled to edit the code. To do this, developers can go to the *Tool* tab and then click on *references* (Figure 9-4) to launch a popup window showing the available reference libraries. Developers need to make sure the libraries for *Microsoft Office 16.0 Object Library, Microsoft Forms 2.0 Object Library, Microsoft Word 16.0 Object Library, OLE Automation, Visual Basic for Applications, Microsoft Scripting Runtime,* and *Microsoft Excel 16.0 Object Library* are selected. Developers select *ok* to close the window (Figure 9-5).

For all tools that rely on VBA (EEAP, BSAP, and CST), the code is saved under the first module. The modules folder can be opened by expanding the modules folder on the left-navigation pane (Figure 9-6).
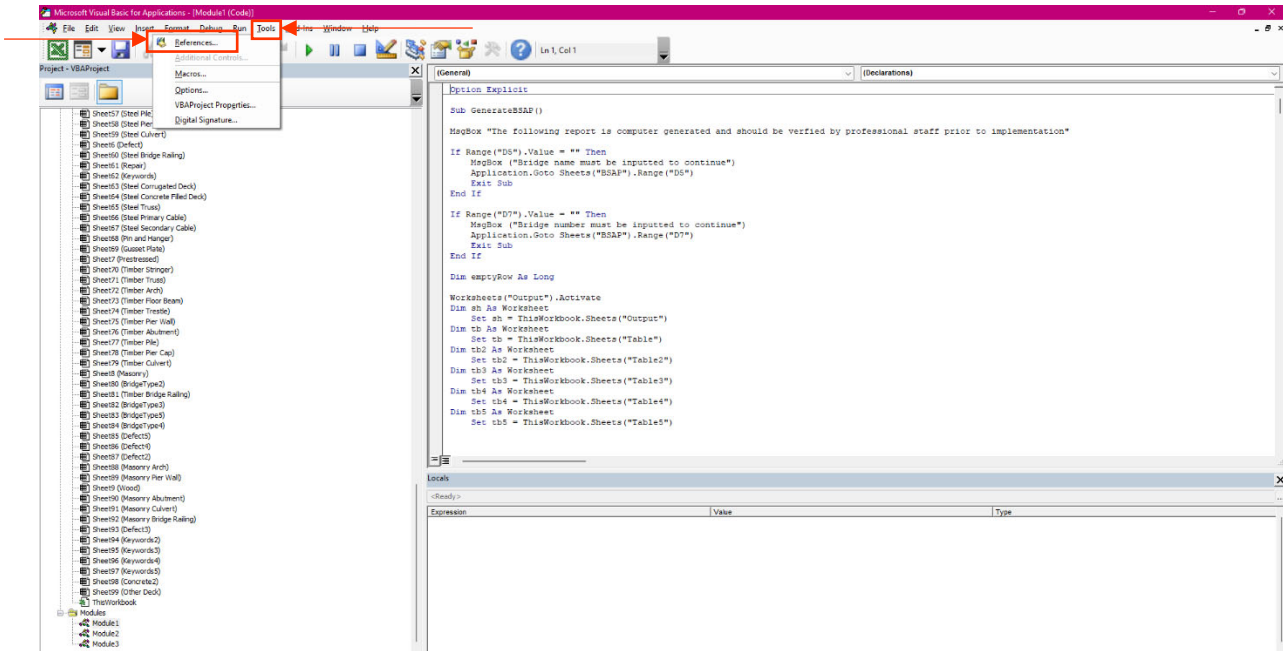
Figure 9-4. VBA Editor Popup Window
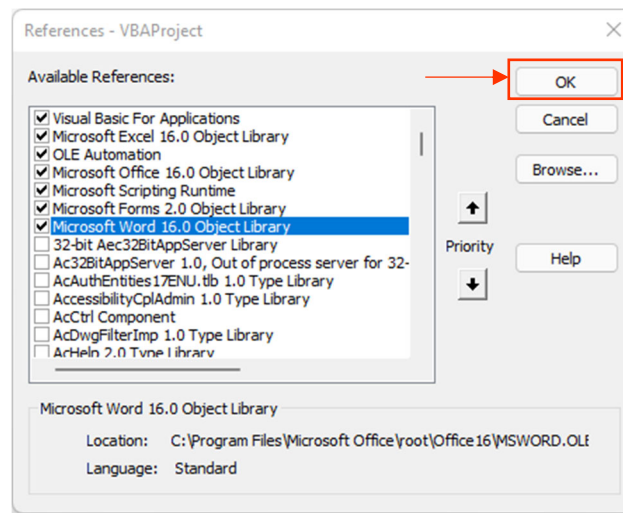
Figure 9-5. Selecting VBA Project References

From the opened code module (Figure 9-7), developers can use the commented text (denoted by quotes ') to navigate to the desired location in the code for editing. Details about implementing specific edits to the VBA code are out of scope for this *Guide*. Developers should turn to department resources for guidance on editing VBA code to meet their specific needs.

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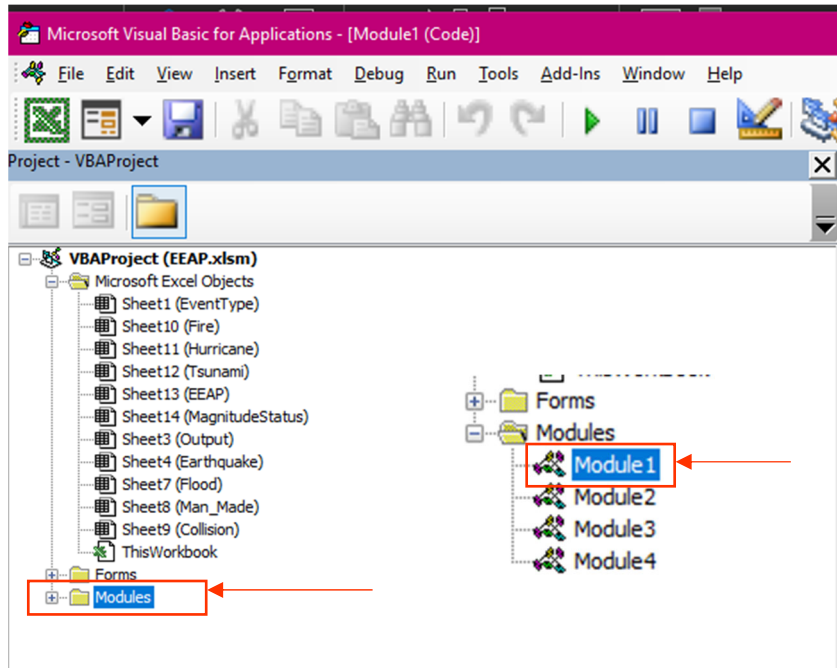
Figure 9-6. Opening VBA Modules to Edit the Code
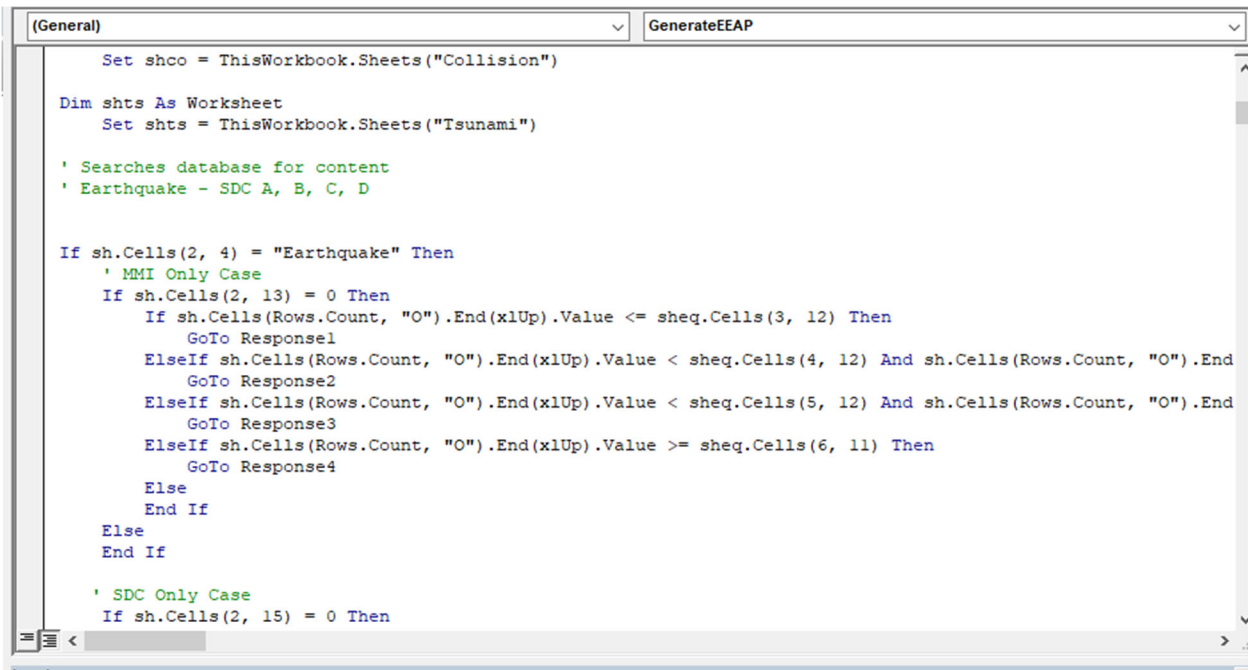
Figure 9-7. Sample VBA Code for EEAP

9.2   General VBA Coding Information

9.2.1   Name Manager

Through the tools, there are a few considerations that developers should make when making changes to the VBA code. First, for EEAP, BSAP, and CST the name manger tool within Excel was used to store and reference formulas. The manger tool can be accessed clicking on the *formulas* ribbon in excel, then selecting *name manager* (Figure 9-8).
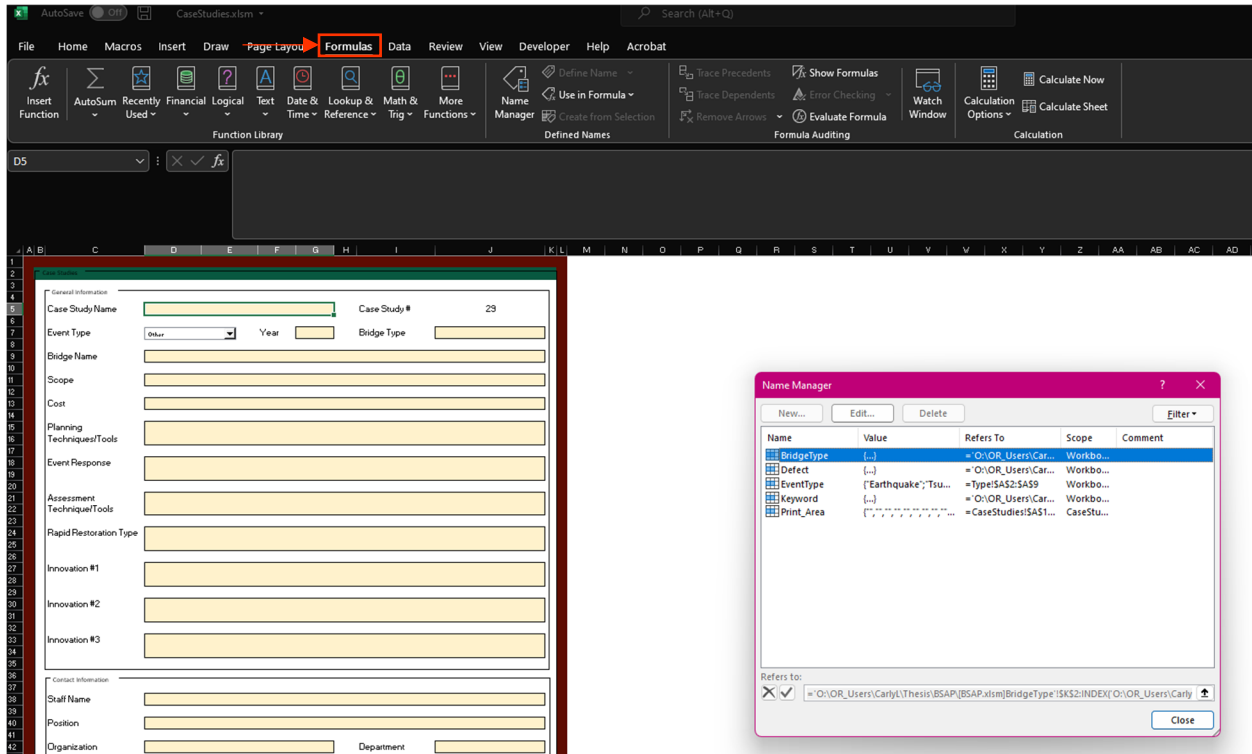
Figure 9-8. Opening the Name Manager

9.2.2   Unlocking Cells

Second, if edits are desired on the first worksheets of EEAP, BSAP, and CST, developers will need to first unlock the cells before making changes the VBA code, as only cells highlighted in yellow are unlocked and editable. To unlock cells, developers click on the *review* ribbon, then select *unprotect sheet* (Figure 9-9).
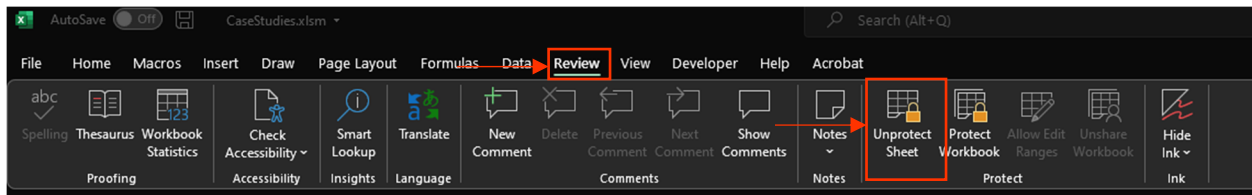
Figure 9-9. Unprotecting Cells in Excel

9.3 Additional Resources

Information regarding VBA editing can be found from the following websites:
- Microsoft Office (https://docs.microsoft.com/en-us/office/vba/api/overview/excel)
- Mr. Excel (https://www.mrexcel.com/)
- Stack Overflow (https://stackoverflow.com/)
- XELPLUS (https://www.xelplus.com/dependent-combo-box/)

There are many additional resources and sample code available online that can be found through web searches as VBA is extensively used to customize Microsoft Office products for many applications.

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